

THE BRITISH
JOURNAL OF SURGERY

THE BRITISH JOURNAL OF SURGERY

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EPONYMS.

By SIR D'ARCY POWER, K.B.E., LONDON.

XXI. HUTCHINSON'S TRIAD.

JONATHAN HUTCHINSON, the second of the eight sons of Jonathan Hutchinson and Elizabeth Massey, his wife, was born at Selby, near York, where his father was a prosperous "middleman in the flax trade", on July 23, 1828. He came of a Quaker stock which had farmed a small estate at Gedney, in the flat lands near Boston, in Lincolnshire, and both his parents were subscribing members of the Society of Friends. Jonathan, in accordance with the practice of the Friends, was educated at home, and it was not until he was 17 that he was apprenticed to Caleb Williams, a Quaker doctor and minister, who had one of the largest practices in York. Eighteen months later he entered the small school of medicine which maintained a precarious existence at York, and where his master lectured on materia medica and therapeutics. Here he came under the influence of Dr. Thomas Laycock, who was also a teacher in the school, and was afterwards Professor of Medicine in the University of Edinburgh. Laycock, perhaps, first drew his attention to the influence of heredity in disease, a subject to which Hutchinson afterwards devoted so much attention. In 1849, the last year of his apprenticeship, he came to London for clinical instruction, as was then the custom, entered at St. Bartholomew's Hospital, and worked in the out-patient room under Paget and in the wards as dresser to Mr. Thomas Wormald. The hospital records make no mention of his holding any post on the junior staff, but that his career was somewhat out of the ordinary is shown by his election as President of the Abernethian Society, the students' debating society, where the officers are chosen by the votes of their contemporaries. He was admitted a Member of the Royal College of Surgeons of England in 1850, having previously obtained the Licence of the Society of Apothecaries. He returned to York immediately to act as House Surgeon at the County Hospital. He came back to London on the expiration of his term of office, and was appointed physician's assistant at the Hospital for Diseases of the Chest, which was then situated in Liverpool Street.

It seems to have been in his mind for a short time to go abroad as a medical missionary, and to this end he devoted himself to gain a sound knowledge of diseases of the eye and the skin by attending the practice of the hospitals at Moorfields and Blackfriars which are devoted to these specialties. During this period, says Sir Rickman Godlee, "he practised a Spartan economy in order to save his father expense, and satisfied himself that the cheapest way of supporting life was a diet of figs and bread". At the same time he contributed weekly "reports from the hospitals" to the columns of the *Medical Times and Gazette*, for which no doubt he received small cheques from time to time. His plan of life seems to have been changed by his election as Surgeon to the Hospital for Diseases of the Skin and Surgeon to the Metropolitan (Free) Hospital, which was then situated in Devonshire Square. He lived for a time at Wallfield, Reigate, and had rooms in Finsbury Circus, in the heart of the City of London, where he had for neighbours members of the staffs of the London and Guy's Hospitals. His position had become assured by 1860, when he was appointed Assistant Surgeon to the London Hospital, for by this time he had made his name as an original observer with the papers on hereditary syphilis to which attention will presently be directed. He gave up his house at Reigate therefore and moved with his wife and his two children to 14, Finsbury Circus, where he lived for the next sixteen years, and built up a remarkable practice by which he supported his wife and the nine children she had borne him. He moved "with some hesitation", he says, to Cavendish Square in 1894, a statement which is amplified by Mrs. Hutchinson when writing to a daughter. She says, "Our going West is very doubtful, I think, after all. Sir James Paget tells papa he *must* go, and give up all hope there of teaching and advancing science, for it is time he attended to No. 1. He can do that there but nothing else. This quite scared papa, and I can't help smiling at how advice, which would attract most men, disgusts him, and he thinks he had better stop here. We have not quite decided yet".

He was elected a Fellow of the Royal College of Surgeons of England in 1862, and in the following year he was appointed Surgeon to Moorfields and Surgeon to the London Hospital, where he was assigned the special duty of lecturing on Diseases of the Eye. He filled, in due course, all the usual offices at the Royal College of Surgeons, was President in 1889 and Hunterian Orator in 1891. He was elected a Fellow of the Royal Society in 1882, had the honour of Knighthood conferred upon him in 1908, and died in 1913.

Sir Rickman Godlee describes him well when he says: "We recall him as a tallish, dark figure, that changed very little from middle life to old age; dark eyes that seemed to look past you through his spectacles; black hair, black beard, lengthening and growing grey with age; a suit of black broadcloth, and a top hat that grudgingly gave place to a wideawake. We see him presiding at our medical meetings and addressing them in precise clear-cut sentences, rather solemn, without much sparkle, but full of meat, and made attractive by more than a trace of Yorkshire accent." Such, indeed, was Hutchinson; a great teacher, an original thinker, a man of wide knowledge and very retentive memory, interested in many forms of education, general as well as professional. He taught not only by the spoken and



SIR JONATHAN HUTCHINSON

written word, but by appeals to the eye. To this end he issued many parts of a vast atlas of diseases of the skin, and wherever possible he illustrated his observations by drawings, photographs, and coloured plates. At Haslemere, where he lived in later life, and at Selby, his birthplace, he established small but carefully selected museums to elucidate the geology, history, and geography of the neighbourhood. It was one of his special pleasures to explain these collections to small parties of visitors gathered from all ranks of society.

For many years he edited *The Archives of Surgery*, and he was the mainstay of the New Sydenham Society, which issued a series of useful translations of French and German works for the benefit of those medical men who only knew English.

Post-graduate teaching made an especial appeal to him, and he was instrumental in founding and carrying on the work of the Polyclinic or Medical Graduates' College in Chenies Street. Throughout his life he showed the thoroughness and tenacity of purpose which was inherited from his Quaker forbears. He maintained that leprosy was due to a fish diet, and travelled widely to secure proofs in support of his hypothesis. He did much to revolutionize the treatment of syphilis in this country, for he taught that the disease should be treated, and not merely the symptoms as was then the usual practice. He was fortunate in living to see the discovery of the agent causing this disease in which he had been interested during his whole working life. He died at his house The Library, Inval, Haslemere, on June 23, 1913.

The foundation of Hutchinson's triad or the tripod he built to support the diagnosis of hereditary syphilis was laid whilst he was still a student. The building was in process of erection for ten years, and was completed in 1861. The successive stories were : inflammation of the eyes ; malformations of the teeth ; deafness.

EYES.

Hutchinson came from York, entered at St. Bartholomew's Hospital, and served as dresser to Mr. Thomas Wormald. Whilst acting in this capacity his attention seems to have been drawn to two patients suffering from a chronic inflammation of the eyes which had long been known to ophthalmic surgeons as 'scrofulous corneitis'.

The first patient was "Mary D., aged 8. Irish. Of this case I have no further notes than that the nose was destroyed, level with the face, by phagedenic ulceration ; that the soft palate was also destroyed ; and, further, that both eyes were affected by kerato-iritis in a severe form. The child came under my observation in St. Bartholomew's Hospital. I considered the case to be one of hereditary syphilis, and Mr. Wormald, under whose care the child was, agreed in the opinion.*

The second patient was "Annie M'Q., aged 14, who came under my observation when she was a patient at St. Bartholomew's Hospital under the

* *Ophthalmic Hospital Reports and Journal of the Royal London Ophthalmic Hospital*, 1859-60, ii, 76, Case 42. Published again in *A Clinical Memoir on Certain Diseases of the Eye and Ear consequent on Inherited Syphilis*, London, 1863, p. 63, Case 42.

care of Mr. Wormald, by whom the syphilitic nature of her symptoms had been fully recognized. She was a puny child of most characteristic aspect. There were nodes on both tibiæ and puckered cicatrices at the angles of the mouth. She was an only child and an orphan, and no history of her infancy was obtainable. About three years ago one of the nodes in the tibia ulcerated, and a piece of bone came away. Nearly at the same time her left eye inflamed, and continued so a long time. The sight was attacked for the first time only three months ago. Much pain in the orbits had attended the attack.

"At the time I saw her, three years after the outbreak of the disease, both irides were thin and mottled in colour; the pupils were adherent and irregular, and the corneæ opaque in their deeper layers. The eyes appeared to be permanently damaged."*

Hutchinson was 21 years of age at the time that these two notes were taken. He worked by the light of them first as Assistant Surgeon at the Metropolitan Hospital, then as a member of the staff of the Royal London Ophthalmic Hospital in Moorfields, and afterwards as Assistant Surgeon to the London Hospital, until he had collected details of sixty-four similar cases. These he published in the first and second volumes of the *Ophthalmic Hospital Reports*, where there is a note that the paper was received on Oct. 18, 1858, and by this time he had given the name of 'chronic interstitial keratitis' to the disease, and the older term 'scrofulous corneitis' was no more heard of. In this paper he gave the following reasons for believing that the disease was the direct result of inherited syphilis:—

"1st. From its being a very well-marked and peculiar form of disease, it is *a priori* probable that it acknowledges some single and definite cause.

"2nd. Its subjects are almost invariably of very peculiar physiognomy, and usually bear the most marked similarity to one another.

"3rd. Its subjects almost invariably have their upper central incisor-teeth of the permanent set dwarfed and notched in a peculiar and characteristic manner.

"4th. In most cases the features alluded to under the last two heads bear no resemblance whatever to those of 'struma' properly so called. The subjects of true struma, on the contrary, usually have large white teeth, and are often of florid complexions.

"5th. I have not yet seen a single case in which the patient was the subject of phthisis, and very few in which enlargement of the glands of the neck had occurred.

"6th. It affects by preference the eldest living child of the family, a circumstance to be expected under the syphilitic hypothesis, but wholly inexplicable under that of struma.

"7th. It affects female children in preference to males, and occurs in families in which a large infantile mortality has usually occurred.

"8th. It occurs in all classes of the community, the well-fed and under-fed, and the residents in the most healthy situations (seaside, etc.), as well as those of crowded cities.

* Op. cit., 76 and 63, Case 43.

"9th. In nineteen out of thirty-one cases in which I was able to make inquiries on the subject, I obtained a confession that one or other parent had suffered from constitutional syphilis prior to the birth of the patient.

"10th. In thirty-two cases out of thirty-eight in which I obtained information as to the health of the patient during early childhood, a clear history of the usual symptoms of infantile syphilis was given.

"11th. In eleven instances there was a clear history of symptoms of infantile syphilis having been observed in brothers or sisters of the patient.

"12th. Whilst, as above observed, enlargements of the lymphatic glands (two cases) are unusual, other affections far more closely connected with syphilis than with true struma, such as nodes (six cases), ulceration of the palate (six cases), and erosive lupus (three cases) are not infrequent in the subjects of this disease."*

By such results from very small beginnings Hutchinson merited the noble eulogium passed upon him by Sir James Paget many years afterwards, when he said: "I venture to make myself proud in calling him one of my pupils. Not my pupil in syphilis; with regard to which I say nothing, but that, at least, I did not interfere with his studies while he pursued them with myself in the out-patients' room of St. Bartholomew's Hospital, where I saw nothing but confusion, and he saw light coming. And I venture to say, if any of us think that in this instance Mr. Hutchinson is looking into outer darkness we shall be very unwise if we neglect his signals when he says that light is come." †

TEETH.

One of the earliest references to what afterwards became known as "Hutchinson's teeth" is contained in a "Report on the Effects of Infantile Syphilis in Marring the Development of the Teeth".‡ Hutchinson says in this report that "for a considerable time past I have been in the habit of recognizing in a certain very peculiar development of the permanent teeth that their possessor had in infancy suffered from hereditary syphilis. A remark to this effect, which I made at a meeting of the Pathological Society early in its past session, being received with expressions of incredulity, it occurred to me that it might be well to make public such evidence as I possessed on the subject." He then proceeded to show casts made by Mr. Alfred Coleman, who was acting as Dentist at the Metropolitan Free Hospital. The cases were thirteen in number taken from patients who were attending the Royal Ophthalmic Hospital at Moorfields for the treatment of chronic interstitial keratitis, an affection, he goes on to say, "which is, I believe, almost always a result of inherited syphilis. Their ages varied from twenty-eight years to five years. In all a clear history of syphilis was established, whether by the free confession of the patient's parents, or by the account given of symptoms of undoubted character during infancy."

* *Ophthalmic Hospital Reports*, 1859-60, ii, 103, 104.

† *Transactions of the Pathological Society*, 1876, xxvii, 373.

‡ *Ibid.*, 1858, ix, 449.

The report was considered sufficiently important to be referred, as was then the custom, to a Committee which, in this instance, consisted of Dr. Graily Hewitt, Physician to the Samaritan Free Hospital for Women and Children; Mr. Henry Lee, Surgeon to King's College and the Lock Hospitals; and Mr. Henry Thompson, then Assistant Surgeon to University College Hospital, who afterwards became well known as Sir Henry Thompson, the urinary surgeon who operated upon the Emperor Napoleon at Chislehurst. The Committee reported on July 14, 1858, that six cases had been examined whose teeth presented certain marked structural and other peculiarities. "The previous existence of syphilis was substantiated in five out of the six cases, and the sixth case was probably of the same character.

"The Committee are disposed to conclude that the relation of cause and effect sought to be made out by Mr. Hutchinson is sustained by a careful examination of the cases referred to, but they hesitate to express a more decided opinion on the number of cases submitted to them. Mr. Hutchinson desires to offer further cases for examination, and the Committee, feeling the importance of the subject, have determined to meet again, and obtain this additional evidence on the subject".*

In the following year Mr. Hutchinson presented a more elaborate and well illustrated paper to the Pathological Society. It was entitled "A Report on Malformations of the Teeth, as indicative of Diathesis",† and is dated Jan. 18, 1859. He summarizes his conclusions in the following words after a consideration of more than seventy cases:—

"I believe that the peculiarities of dental malformation which I have described occur in subjects of hereditary syphilis:—

"1. Because, in cases of interstitial keratitis, a disease which I have elsewhere endeavoured to prove to be of hereditary syphilitic origin, these peculiar teeth are almost invariably met with.

"2. Because I have hardly ever seen teeth of well-characterized syphilitic type, excepting in patients who either had keratitis at the time they were under observation, or had had it at some former one.

"3. Because these teeth are usually found coincident with the physiognomy of hereditary syphilis.

"4. Because in a large majority of cases where these teeth are seen, a clear history of infantile symptoms is obtainable.

"5. Because in not a few instances, the parents of children with these teeth have spontaneously informed me that they had suffered from syphilis prior to the child's birth, and that the latter had also been treated in infancy for the same.

"6. Because I have repeatedly seen these teeth in patients the known subjects of hereditary syphilis, but who had never taken mercury.

"7. Because I have often examined the teeth of those, not the subjects of syphilis, who in infancy had taken courses of mercury, without ever once finding the syphilitic type of teeth at all closely simulated.

* *Transactions of the Pathological Society*, 1858, ix, 456.

† *Ibid.*, 1859, x, 287-299.

"8. Because I have repeatedly ventured to pledge myself to a diagnosis of hereditary syphilis founded solely on the state of the teeth, and subsequently found that the patient's history placed the correctness of the opinion beyond a doubt.

"9. Because the teeth described are not met with in subjects of any of the forms of struma, properly so-called. Thus the teeth of phthisis have long been known to be remarkable for their brilliant pearly-whiteness and fine form; and out of thousands of cases of strumous varieties of ophthalmia (i.e., the ulcerative, pustular, etc., superficial and not interstitial), in which I have looked at the teeth, I have never once seen them of marked syphilitic type. A similar statement to the last I may also make as regards numerous cases of true glandular struma in which I have examined the teeth, and found them usually of large size and good form.

"10. Because the same clinical evidence which has been satisfactory to myself has also proved convincing to many other much better observers, including the whole surgical staff of the Ophthalmic Hospital."

Here, as in the case of interstitial keratitis, Hutchinson's demonstration was so conclusive that the teeth gradually came to be accepted as a proof of hereditary syphilis.

DEAFNESS.

Mr. Jonathan Hutchinson, Assistant Surgeon to the London Hospital and Surgeon to the Metropolitan Free Hospital, in conjunction with J. Hughlings Jackson, M.D., Assistant Physician to the Metropolitan Free Hospital, both young Yorkshiremen, published a paper in the *Medical Times and Gazette* which appeared on Nov. 23, 1861.* It is a short report on "Cases of Deafness associated with Syphilis", in which they state that "cases of deafness in association with congenital syphilis are not uncommon; but here we are not able so distinctly to name the special structures attacked as in the case of syphilitic disease of the eye. Of one hundred cases of congenital syphilis collected by Mr. Hutchinson, ten were noted to have been deaf, and of these nine became deaf after otorrhœa". The details of three cases are then given, but only one was definitely associated with hereditary syphilis. The patient was "Eliza T., aged 15, who was admitted under the care of Mr. Hutchinson, at the Metropolitan Free Hospital, on October 23 (1861?). The aspect of hereditary syphilis was well marked. Teeth typical. The irides were steel grey, pupils irregular, and the corneæ dim from an attack of kerato-iritis at the age of three years. For this attack she attended at Moorfields for one year, under the care of Mr. Critchett. She regained fair health, and was able to read easily. She had good hearing until about three years ago; she had then some pain and much noise in the ear. The right ear began to fail first, but the other began soon after; and in the course of a year she had complete loss of all hearing. There was at no time the least discharge, until the last few months, when a little watery fluid has run out. She is now quite deaf, and

* *Medical Times and Gazette*, 1861, ii, 530.

can converse only by her fingers (the deaf and dumb alphabet). Since her deafness she has got to speak thickly and almost in a whisper. Her mother had had six children, of whom the patient is the youngest living. She (the patient) when an infant had a slight rash; when nine months' old she had for two months a fit of illness, but no special symptoms of it are recollected. Three brothers, older than the patient, are well, and have never ailed anything particular. Two girls, one born before Eliza and one after, died in infancy."

In the *Clinical Memoir*, referred to on page 3 (footnote), and elsewhere, Hutchinson demonstrated the following features of the deafness due to inherited syphilis:—

1. It is, like interstitial keratitis, a symmetrical disease, in the sense that both eyes or both ears are sooner or later affected.

2. It occurs about the same period of life—childhood or puberty. There are some exceptions to this rule.

3. It is much rarer than interstitial keratitis, and even more intractable to antisyphilitic treatment. A patient with keratitis, however severe, usually recovers a fair amount of vision; the deafness is as a rule both of high degree and permanent.

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It is of interest to note that hardly anything has been added to our knowledge of these subjects since Hutchinson published his observations some sixty years ago. Many attempts were made to controvert them, but in no single point has their accuracy been disproved.

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It may be added that in the subjects of interstitial keratitis, etc., the persistence of a positive Wassermann reaction, in spite of treatment, is remarkable.

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THE IMPORTANCE OF HÆMATOLOGY IN SURGERY.

By A. PINEY, LONDON.

(Being two Arris and Gale Lectures delivered before the Royal College of Surgeons on February 17 and 19, 1926.)

THE employment of the findings of morphological hæmatology in the routine investigation of clinical cases has been much neglected by the surgeon; even when such an examination has been carried out, the interpretation of the findings has presented much difficulty and has often been mistrusted. It is the purpose of the first part of this paper to show that some of the commonly accepted deductions need much modification before they can serve the purposes of the practitioner. An extreme degree of leucocytosis has often been noted in cases without suppuration, and, conversely, leucopenia has often been seen in cases in which operation has revealed the existence of a large collection of pus. It is such apparent contradictions between the clinical and hæmatological results which must necessarily shake the surgeon's trust in these laboratory methods of examination. I wish immediately to emphasize the fact that the size of a leucocytosis is not the feature on which most stress is to be laid, just as the size of a tumour can give little information as to its nature. The one method of real value must depend upon detailed examination of the constituent cells; this is admitted in regard to neoplasms, and here it is hoped to show that the same technique must be used in examination of the blood.

The subject presents many inherent difficulties, and these are in no way lessened by the existence of an enormous literature. I shall confine myself as far as possible to records of personal experience both in observation and in interpretation.

A very brief introductory account of the essential theoretical bases of hæmatology must precede the discussion of the surgical applications of the subject.

THE BLOOD-CELLS.

Examination of suitably stained films of blood shows the presence of red corpuscles, granular leucocytes, non-granular leucocytes (lymphocytes), and platelets. The red corpuscles and the granular leucocytes are formed in the bone-marrow, whereas lymphocytes are produced in lymphatic glands, spleen, and lymphoid tissue throughout the body. The schema given on the next page shows the genealogical tree of the blood-cells. A number of types are omitted for the sake of simplicity.

It will be noted that the original parent cell of the mature granular leucocytes (myeloblast) is non-granular, but there is now no doubt that most of the mature granulocytes in the blood are derived from myelocytes, i.e.,

can converse only by her fingers (the deaf and dumb alphabet). Since her deafness she has got to speak thickly and almost in a whisper. Her mother had had six children, of whom the patient is the youngest living. She (the patient) when an infant had a slight rash; when nine months' old she had for two months a fit of illness, but no special symptoms of it are recollected. Three brothers, older than the patient, are well, and have never ailed anything particular. Two girls, one born before Eliza and one after, died in infancy."

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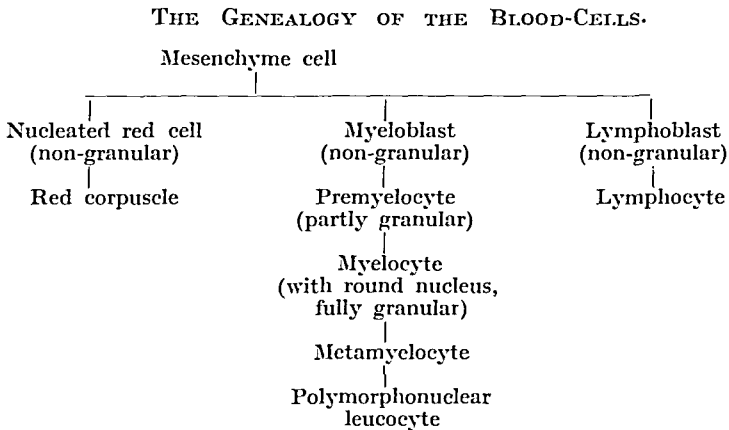
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It will be noted that the original parent cell of the mature granular leucocytes (myeloblast) is non-granular, but there is now no doubt that most of the mature granulocytes in the blood are derived from myelocytes, i.e.,

from fully granular cells (Ellermann). It is clear from the chart that the cells with definitely lobulated nuclei (polymorphonuclear leucocytes) are more mature than those with a single round nucleus—a difference which is also shown by the greater density of the nuclei of the former. The intermediate stage in which the nucleus is bent but is not definitely lobulated is known as the metamyelocyte, which is often erroneously included with the polymorphonuclears. Arneth has appreciated these fine details very fully, and has contended that it is only a logical extension of this knowledge to regard a polymorphonuclear cell with a large number of lobes as being older than one with only two. He has supported this conception in numerous publications, and has attempted to show that normally a definite percentage of cells of each nuclear type, viz., 2-, 3-, 4-, and 5-lobed, is present in the blood. This teaching has been applied to all types of blood-cells, but most of the work has dealt with those elements containing neutrophilic granules. Arneth's



method is very laborious and is subject to many fallacies; in addition there is the objection that the evidence that greater maturity is always expressed by greater complexity of the nuclear lobes is meagre.

It would seem obvious, however, that some simpler method based upon the facts known as to the maturation of myelocytes into polymorphonuclear leucocytes might be elaborated so as to serve the purpose of gaining a deeper insight into the finer biological processes at work in many infections. It is mainly to the work of von Schilling-Torgau that we owe an accurate method based on such considerations; it is a method sufficiently simple to be used even for routine examination. He has pointed out that it is possible and reasonably easy to distinguish the cells with neutrophilic granulations into several obvious groups, which certainly contain cells of different degrees of maturity, viz.: (1) Cells with completely round nuclei (myelocytes). (2) Cells with slight nuclear indentation, i.e., young metamyelocytes; he refers to these as 'Jugendformen' (young forms). (3) Cells in which there is no true nuclear lobulation, but in which the nucleus is arranged as a long, narrow, bent mass, i.e., ordinary metamyelocytes. These are cells to which he refers as 'Bandformen' and we may call band nuclei. (4) Cells with definite nuclear segmentation, i.e.,

typical polymorphonuclear leucocytes; all these last are classed together. It is perfectly easy to note that, in normal blood, the cells with neutrophilic granulation and band nuclei always form about 4 per cent of the total leucocytes; wide variations occur in pathological conditions, as will be pointed out later.

It is necessary to emphasize a few further facts before describing actual examples of hæmatological interpretations. The neutrophilic leucocytes form the usual cellular response to the great majority of infections, and are liable to suffer injury when exercising their defensive powers; this change is seen in its most extreme degree in pus-cells. In blood the changes are less severe but require to be carefully noted. The alterations affect either the cytoplasm or the nucleus, but as a rule abnormalities can be seen in both constituents. Increased density of the nucleus (pyknosis), with loss of normal distinction of basi- and oxy-chromatin, clumping of cytoplasmic granules, or even their disappearance in places, are common, while vacuolation of the cytoplasm may occur in severe infections (*Fig. 1*). Changes of this type will obviously render it much more difficult or even impossible to determine accurately the number of nuclear lobes as required in Arneth's method, whereas it in no way decreases the value of the technique here recommended.

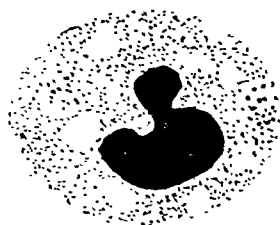


FIG. 1.—Diagram of polymorphonuclear leucocyte showing changes due to toxic influences, viz., pyknosis of nucleus, clumping of granules, and vacuolation of cytoplasm.

The other types of cells arising in the bone-marrow (myeloid leucocytes) cannot advantageously be classified in a similar manner. The eosinophilic and basophilic granular cells can simply be enumerated, because any more complex classification is not possible in the present stage of our knowledge of them. The large hyaline leucocyte (monocyte) is still too much the subject of controversy to be accurately classified. Even the source of this cell is still a matter of dispute. One of the most recent views as to its origin is that of Aschoff and Kiyono, who regard it as being derived from reticular supporting tissue, which is present in almost all parts of the body, i.e., from the so-called reticulo-endothelial system. It is convenient and probably accurate to accept the view of Naegeli and Alder as a working hypothesis, viz., that the monocyte is derived from the myeloblast, i.e., from the parent cell of the granular leucocytes.

Lymphocytes are always, so far as is known, derived from pre-existing lymphatic cells; sometimes from obviously immature forms (lymphoblasts), which bear a slight resemblance to myeloblasts.

LEUCOCYTOSIS AND LEUCOPENIA.

It is essential to consider these subjects together, because, as a rule, they represent simply differences in the intensity rather than in the kind of response. The terms can be applied to increases or decreases respectively of all types of leucocytes, but it is often convenient to specify more accurately by speaking of neutrophilia, eosinophilia, basophilia, lymphocytosis, or monocytosis.

viz., the lymphocytosis indicative of the disease being held in check has gone. This is an example of

4. **Increased Functional Demand as a Cause of Lymphopenia**, which is usually a condition of the worst possible prognostic significance; but it must be recognized that leucopenia is not necessarily a process fundamentally different from leucocytosis. There are toxins which can give rise to leucocytosis or leucopenia according to their concentration, just as there are others which primarily inhibit cell production rather than stimulate it; e.g., the leucopenia of typhoid fever or of measles after the rash has appeared must be regarded as belonging to this latter group of cases.

It can be taken as a general rule that the absence or disappearance of the leucocytic response usual in any infection is of bad significance; e.g., the disappearance of the eosinophilia so typical of scarlet fever is seen only in very severe cases; this is an example of

5. **Increased Functional Demand as a Cause of Eosinopenia**; but the much more commonly observed condition is

6. **Increased Functional Demand as a Cause of Eosinophilia**, such as is seen in post-infective states, but particularly in association with infestations with parasitic worms, e.g., hydatids. In this connection it is well to remember that secondary infection of a hydatid cyst is accompanied by neutrophilia with great reduction of eosinophils. Eosinophilia seems to be a much less stable state than neutrophilia; i.e., the response of the body to the more lethal infections, which are accompanied by neutrophilia, is the more mobile.

7. **Decreased Functional Activity as a Result of Destruction of Formative Tissues**.—Extreme lymphopenia may result from widespread destruction of lymphatic tissue throughout the body, e.g., by tuberculosis. The most severe example of failure of the hæmatopoietic tissues is, of course, seen in aplastic anemia; but a very severe form may accompany the great destruction of myeloid tissue resulting from infiltration by numerous metastatic malignant tumours.

8. **Increased Functional Activity as Result of Greater Size of Formative Tissues**.—The most obvious example of this type is found in the leukæmias, where the greatly increased amount of marrow is not, so far as is known, the result of increased functional demand.

Another example of greater surgical interest is found in status lymphaticus, in which condition there is excess of lymphatic tissue throughout the body associated with lymphocytosis in the blood. It would also seem to be possible that the lymphocytosis seen in such endocrine disturbances as exophthalmic goitre is due to some similar hyperplasia; this is observed most notably in the thymus in this malady.

9. **Increased Functional Activity as a Result of Irritation**.—This is seen most typically in cases in which a deposit of tumour (carcinoma or sarcoma) occurs in the bone-marrow. Leucocytosis, with emigration of immature cells of both the leucocytic and red series into the peripheral blood, results. Histologically, as might be expected, there are signs of destruction of marrow tissue as well as of its stimulation.

10. **Decreased Functional Activity as a Result of Persistent Demand**.—This group of cases is perhaps rather arbitrarily separated from those in (2),

but there seems to be good histological reason for so doing. Cases of prolonged suppuration may, after a time, show progressive diminution in the number of circulating leucocytes, although there has previously been well-marked leucocytosis. Here there is definitely degenerative change in the bone-marrow, i.e., there is more than simple failure to respond to a stimulus. Gelatinous degeneration is the histological expression of this state; the marrow-cells are decreased in number, and the interspaces are filled with structureless material, which may ultimately almost replace the myeloid tissue proper.

Figs. 2-7 illustrate some of the conditions here described.

THE RED CORPUSCLE AND ITS PATHOLOGY.

It is convenient at this point to describe some of the characters of the red cells, although they are usually of less interest to the surgeon than are the leucocytes. Red cells are formed only in the bone-marrow in extra-uterine life, but whether they are derived from an ancestral cell common to them and to the granular leucocytes, as suggested by Klein, or whether they have a separate mode of origin, is still uncertain. Whatever may be the truth as to the origin of the red cell, it is certain that it tends to undergo alterations in number and in structure as a result of stimuli similar to those occasioning leucocytic variations. It is essential to realize that one form of nucleated red cell (the megaloblast) is peculiar to embryonic life and to only two diseases, viz., pernicious anæmia and acholuric jaundice.^{24,25} Most of the cells referred to in medical literature as megaloblasts are doubtless large normoblasts (macro-normoblasts).

The anæmias can be of little interest to the surgeon with the exception of those forms following hæmorrhage or long persistent chronic infections.

1. **Post-hæmorrhagic Anæmia** is a condition which very clearly shows some of the close inter-relationships between the leucopoietic and the erythropoietic mechanisms, i.e., between both main constituents of the bone-marrow. In the blood there are all the signs of active replacement of red corpuscles, and at the same time there is evidence of great production of leucocytes, which is seen in the form of well-marked neutrophilic leucocytosis.

It is convenient to include the various conditions in which blood is destroyed inside the body with the post-hæmorrhagic anæmias, e.g., anæmia due to snake venom and other hæmolytic poisons. There is, however, a very striking difference in the speed of regeneration of the blood in the two types of cases. In the hæmolytic ones the blood is brought back to normal much more rapidly than in those due to spilling of blood; these divergences seem to depend upon the retention of iron in the body in the former type of case. McMaster and Haessler have shown clearly that one of the main factors governing the spread of red marrow in the bones is the amount of iron available in the body.

2. **The Anæmia of Chronic Infections.**—It has already been pointed out that, when one type of leucocyte is produced in numbers much greater than normal, the other white cells are much decreased in quantity, and it seems that a demand for one type of leucocyte can cause grave disturbance of the normal correlation of the cytopoietic functions of the marrow if it persists

for sufficiently long; even the red cells may suffer from too long a leucocytic drain. The latter type of damage is as a rule slight, and is shown by some degree of anæmia associated with signs of active regeneration of the blood, viz., polychromasia, nucleated red cells, and punctate basophilia in the circulation. Much more rarely a true degeneration of the formative tissues occurs and the signs of active regeneration disappear from the blood, so that a form of aplastic anæmia results; both chronicity and severity of infection are factors in the occurrence of such a state.

3. Anæmia due to Injury of the Marrow is best illustrated by aplastic anæmia such as occurs occasionally in radiographers;²⁶ but a condition of greater surgical interest is that in which metastases of malignant tumours invade the marrow and injure parts of it, while stimulating the adjacent portions to greater, but less orderly, proliferation.

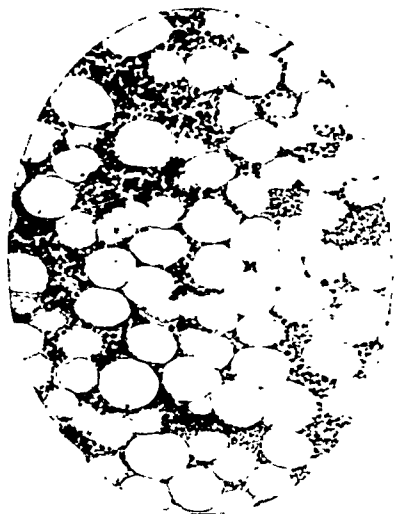


FIG. 2.—Normal bone-marrow.
($\times 90$.)

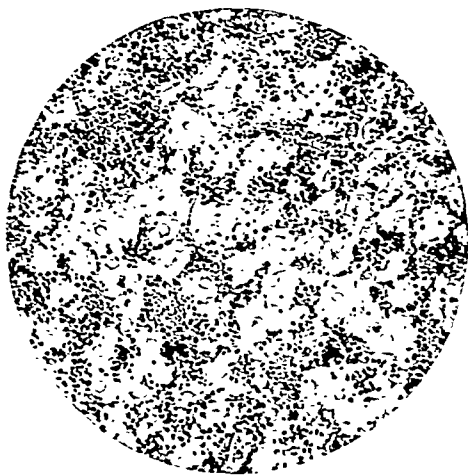


FIG. 3.—Gelatinous degeneration of bone-marrow, showing the decrease in the number of cells, together with deposition of structureless material in the interstices of the tissue. The tissue is from a case of persistent suppuration of a tuberculous knee-joint which had lasted several years. ($\times 90$.)

In this condition, many nucleated red cells appear in the circulation; there is always a far greater number than would be seen in a secondary anæmia of similar degree. More rarely a very large number of erythroblasts may be seen in such a case even in the absence of anæmia; here the irritative stimulus of the metastasis is greater than is its destructive power. The more typical case must be presumed to possess its characteristic features as a result both of progressive destruction and stimulation of the myeloid tissue as a whole.

The characters of the erythrocytic blood picture are as a rule of little surgical importance, but it may be convenient to indicate some of the deductions which may be drawn from them:—

1. Polychromasia and punctate basophilia in a blood with normoblasts in small numbers and a tendency for the leucocytes to approach normal are of good significance.



FIG. 4.—Hyperplastic bone-marrow, showing the decrease in number of fat spaces and the great excess of cellular tissue. The specimen was taken from a case of tuberculosis of the knee with secondary infection; leucocytosis had been observed for three months. ($\times 90$.)



FIG. 5.—Hyperplastic bone-marrow, showing a part of the tissue seen in *Fig. 4* at a higher magnification. The characters of the proliferated cells are better seen, and the participation of even the megakaryocytes is obvious. ($\times 225$.)

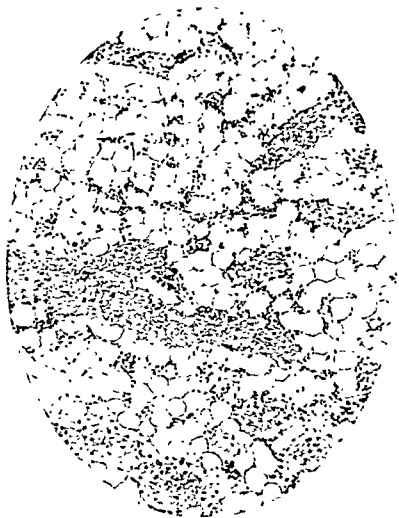


FIG. 6.—Depletion of bone-marrow, showing almost complete absence of cells, with no signs of regeneration. The case was one of pneumonia following perforation of a gastric ulcer. ($\times 90$.)

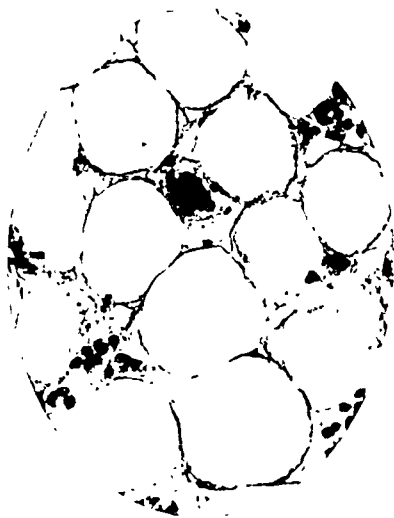


FIG. 7.—Depleted and injured bone-marrow, showing a part of the tissue seen in *Fig. 6*, at a higher magnification. The pyknosis of the nuclei is clearly seen. ($\times 225$.)

2. A similar picture, but with the signs of regeneration much more intense, does not necessarily imply that the process of repair will be successful; much more frequently the prognosis in such a case is bad.

3. Persistently low numbers of red corpuscles, with scanty signs of regeneration such as absence of polychromasia, etc., and of normoblasts, is of evil significance; particularly is this so when associated with leucopenia, and perhaps even relative lymphocytosis.

THE LEUCOCYTIC BLOOD PICTURE.

The interpretation of various leucocytic blood pictures can now be discussed. In the following tables the leucocytes are arranged in the conventional manner; but the neutrophils are divided into myelocytes, young forms, band forms, and polymorphonuclears (mature forms) in the manner described above. The approximately normal percentage figures for the various types of leucocytes are as follows:—

Leucocytes, 6000 to 8000	Eosinophils, 3 per cent
Neutrophils, 67 per cent, of which 4 per cent are band forms and 63 per cent are polymorphs	Basophils, 1 per cent
	Lymphocytes, 23 per cent
	Monocytes, 6 per cent

It is most important to note that about 4 per cent of the neutrophils are of the band type, i.e., are slightly immature.

The character of the variations in infective conditions is well seen in the following case of joint suppuration in septicæmia. On the first day there is well-marked 'shift to the left' of the neutrophil nuclei, i.e., there is increase of the immature forms. There are 19 per cent of the young type and 17 per cent of the band form; it was not possible at this time to do more than state that the infection was indubitably a grave one, but no prognosis could be made. On the second day there was an orderly tendency to a return towards the right, i.e., towards maturity of the majority of the cells, although there were still many immature neutrophils; the less immature band type was present in larger numbers than the young type, whereas on the first day the strain on the marrow was so great that the young type was the more numerous. It was now fairly clear that such a leucocytic reaction was of good prognostic significance. On the twenty-first day, there was no longer any excess of immature forms, but the eosinophils were still scanty; this defect was over-compensated by the twenty-fourth day, when a well-marked eosinophilia occurred. The numbers of leucocytes are shown below:—

DAYS	TOTAL LEUCOCYTES	BASOPHILS	EOSINOPHILS	NEUTROPHILS				TOTAL NEUTROPHILS	LYMPHOCYTES	MONOCYTES
				Myelocytes	Young Types	Band Types	Polymorphs			
1	8500	—	—	—	19	17	31	67	19	14
2	7800	—	—	—	10	27	27	64	21	15
21	7300	—	1	—	—	1	56	57	29	13
24	10000	—	15	—	—	—	57	57	22	6

The next case was hæmatologically examined only by chance after operation for internal derangement of the knee. *Fig. 8* shows graphically the series of leucocytic changes in this case, which steadily progressed to a fatal termination. The percentage

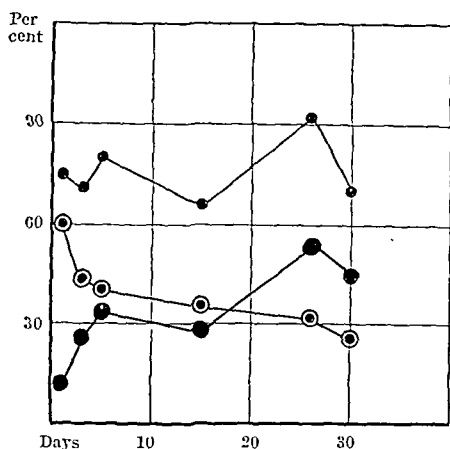


FIG. 8.—●—● = Total neutrophils
○—○ = Mature neutrophils
●—● = Immature neutrophils

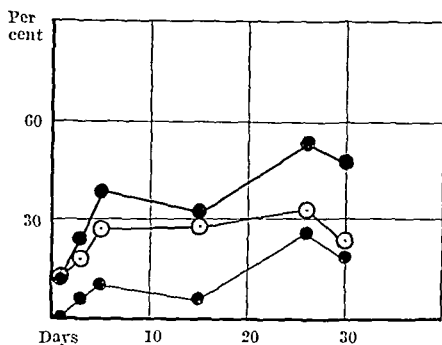


FIG. 9.—●—● = Total immature leucocytes
○—○ = Band forms
●—● = Young forms

of neutrophils was almost steady throughout the course of the illness, but gradually the immature forms became more numerous until they were in excess of the mature polymorphonuclear type.

Fig. 9 shows the condition in rather finer detail because here the young forms and the band types are charted separately, and it is easy to note that it is the young forms which

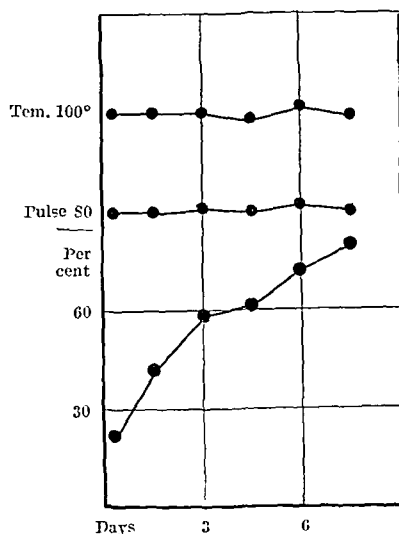


FIG. 10.—The rising percentage of immature cells (lowest curve) is clearly seen.

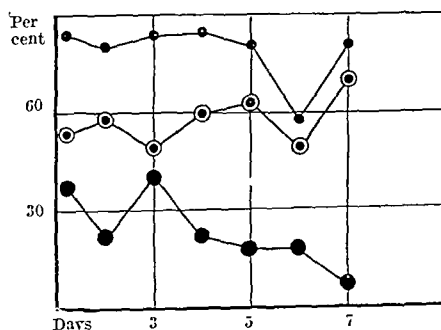


FIG. 11.—●—● = Total neutrophils
○—○ = Mature neutrophils
●—● = Immature neutrophils

increase; i.e., the marrow disturbance is so great as to result in production and emigration of cells only slightly more differentiated than myelocytes; this is a type of cell normally quite absent from the circulation.

Fig. 10 shows a feature of very great importance in a case of peritonitis. The temperature and pulse gave very little cause for anxiety, but the percentage of immature cells rose steadily (shift to the left), so that there could be no doubt as to the fatal termination of the case, which occurred on the seventh day of the illness.

It must not be supposed that features of importance can be obtained from the leucocytic picture only in fatal cases. *Fig. 11* shows the series of changes in a case of erysipelas of moderate severity in which the clinical signs were most striking on the third day; this is seen to correspond to the time of maximum percentage of immature neutrophils on the chart. It is noticeable that on the seventh day there is an increase in the percentage of neutrophils, which might have been taken to indicate a recrudescence of the infection, but the progressive decrease of the less differentiated neutrophils was sufficient evidence to negative this view. It is obvious therefore that simple enumeration of the percentage of neutrophil leucocytes is not the sole or indeed the most accurate guide; the really important evidence is to be obtained by the discovery of either a rise or a fall of the immature types. It is not sufficient to find a steady percentage of mature cells or even a rising one, because rarely such a phenomenon may accompany a steady increase of the immature ones also; such a condition is of very evil prognostic significance. The factors governing the total numbers of neutrophilic leucocytes in the circulation at any one time are doubtless very numerous, and certainly are but little understood, whereas almost the only mechanism that is capable of causing progressive increase of immature forms is an infection; i.e., interpretation of variations in the total numbers of leucocytes is most likely to be subject to grave error.

The case shown in *Fig. 12* was one of pneumonia following laparotomy for perforated gastric ulcer and generalized peritonitis. It is seen that at the time of the first examination—which took place on the fifth day of the illness—the mature cells were already less numerous than the immature ones. There is a progressive and steady rise of the immature forms until death, which took place on the eleventh day of the disease.

If only the mature cells were taken as evidence of the gravity of the condition, it would be obvious that the prognosis was bad: but their fall is not as steady as is the rise of immature forms. If all the neutrophils were considered together, it would be easy to mistake the fall on the third day for evidence of improvement; but a glance at the numbers of immature cells is enough to negative this idea. *Fig. 13* presents a similar picture from the same case: but here the gravity of the condition is even more obvious, because the young and the band forms are separately charted. The strain on the resources of the bone-marrow is so great that

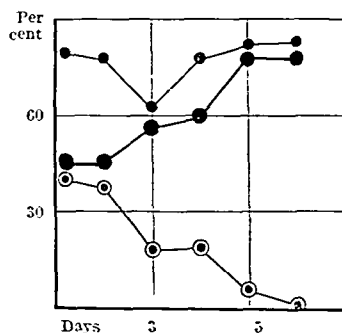


FIG. 12.— ●—● = Total neutrophils
○—○ = Mature neutrophils
●—● = Immature neutrophils

the mature neutrophils and the band forms drop steadily while the young forms progressively rise, so that it is obvious that almost all the cells with neutrophilic granulation at the end of the disease are elements of a kind

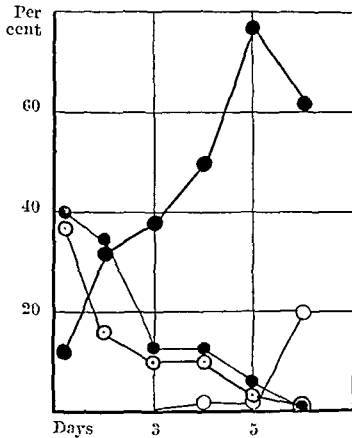


FIG. 13.— ●—● = Young forms
○—○ = Band forms
●—● = Mature neutrophils
○—○ = Myelocytes

normally absent from the circulation; no better example of the importance of examining the cells as well as counting them could possibly be adduced. In this case the strain on the bone-marrow was so great that myelocytes appeared at the end of life; but it must be pointed out that myelocytes may appear in cases without such great shift to the left, and then have no evil significance.

It may well be objected that a method of examination which requires to be repeated so frequently is of little value to the clinician, even if it is of great theoretical interest. This view is not really correct, because, as the following examples will show, much information of value can often be obtained from a single examination; but, of course, this is never so satisfactory a method.

It is well first to mention a case in which the changes were very well marked.

The clinical diagnosis was one of abscess formation in the pelvis, and the blood examination showed:—

Leucocytes, 20,000
Neutrophils, 94 per cent, of which 19 per cent were young forms and 14 per cent were of band type, leaving 61 per cent of mature cells

Eosinophils, nil
Basophils, nil
Lymphocytes, 5 per cent
Monocytes, 1 per cent

There were well-marked leucocytosis and great increase in the number of immature cells in association with absence of eosinophils, so that no doubt as to the presence of pus could be entertained. The diagnosis was confirmed at operation.

The next case was clinically much less definite; there were slight rise of temperature, slight abdominal rigidity, and pain in the right iliac fossa. The provisional diagnosis was appendicitis. The blood picture was as follows:—

Leucocytes, 8000
Neutrophils, 75 per cent, of which 12 per cent were of band type and 63 per cent were mature

Eosinophils, 1 per cent
Basophils, nil
Lymphocytes, 16 per cent
Monocytes, 8 per cent

The leucocytes were not in excess of normal numbers, and there was not even a distinct relative neutrophilia. There was, however, slight shift to the left of the nuclei, although eosinophils still persisted in small numbers. It was clear that no inflammation or suppuration of severe character could be present, and at operation a scarred and slightly oedematous appendix was found.

IMPORTANCE OF HÆMATOLOGY IN SURGERY 21

The next case presented great clinical difficulties, in that a complaint of pain in the right iliac fossa was made by a mentally defective man, who had a scar in this region but could give no history of its origin. The blood showed :—

Leucocytes, 7500	Eosinophils, 1 per cent
Neutrophils, 48 per cent, of which 1 per cent were of band type and 47 per cent were mature	Basophils, nil
	Lymphocytes, 49 per cent
	Monocytes, 2 per cent

A blood picture of this type could not be reconciled with a diagnosis of inflammation, because there was no leucocytosis, no shift to the left of the neutrophils, and the eosinophils persisted although rather reduced in number. The definite lymphocytosis in association with the reduction of eosinophils seemed to indicate the presence of some chronic irritative but aseptic condition. At operation the appendix could not be found, but very dense adhesions were present in the region of the cæcum.

The next case was hæmatologically examined in the course of an investigation of the blood changes associated with convulsions. The patient suffered from Jacksonian epilepsy, and gave a history of a head injury some eight months previously; a dense scar was present on the scalp. The blood showed :—

Leucocytes, 6000	Eosinophils, 1 per cent
Neutrophils, 79 per cent, of which 8 per cent were young forms, 33 per cent were of band type, and 38 per cent were mature	Basophils, nil
	Lymphocytes, 8 per cent
	Monocytes, 12 per cent

No other case of convulsions had been observed with a blood picture even remotely resembling this one, and the characters were obviously those already recognized as due to infection. At operation, a cerebral abscess was found instead of a cortical scar, which had been presumed to be the cause of the convulsive attacks.

There can be but little purpose in increasing the number of examples of interpretation of leucocytic blood pictures here; enough has been said to make clear that a single blood examination may often be a sufficient guide to diagnosis, although definite prognostic indications can, as a rule, only be obtained by repeated examinations.

There are, of course, other types of blood picture in which some cell other than the neutrophilic granular leucocyte supplies the indications required by the clinician. Changes in the number of lymphocytes may be of great diagnostic importance, and are always of great theoretical interest. Most of the disorders of the endocrine tissues are accompanied by some variation affecting the lymphocytes, as is seen distinctly in the following case of exophthalmic goitre which was clinically typical :—

Leucocytes, 6300	Eosinophils, 5 per cent
Neutrophils, 49 per cent, of which 1 per cent were young forms, 3 per cent were of band type, and 45 per cent were mature	Basophils, nil
	Lymphocytes, 38 per cent
	Monocytes, 8 per cent

Here there is slight but definite lymphocytosis; the eosinophils are near the high limits of normal, and there is slight shift to the left of the neutrophils.

There is thus a peculiar mixture of hæmatological change: lymphocytosis and eosinophilia with shift to the left of the neutrophils, which is a condition very different from that seen in the infections discussed above.

A more intense example of changes of this character was seen in a case of adrenal tumour associated with alterations of the secondary sex characters:—

Leucocytes, 6700	Eosinophils, 8 per cent
Neutrophils, 39 per cent, of which 1 per cent were young forms, 2 per cent were of band type, and 36 per cent were mature.	Basophils, 1 per cent
	Lymphocytes, 37 per cent
	Monocytes, 15 per cent

Here the eosinophilia is even more marked. Monocytosis is common, but not invariable, in cases of endocrine disturbance.

Unfortunately it is not at present possible to make definite diagnoses in such cases simply from the blood picture, because defective functioning of other glands may give rise to similar changes. Lymphocytosis and eosinophilia are seen in association with polycystic kidneys, although here no shift to the left of the neutrophils occurs. In any case with a blood picture of this type it is essential to think first of the possibility of the condition having arisen after an infection, i.e., as a post-infective lymphocytosis with eosinophilia and monocytosis. It is, of course, obvious that examination of the blood must be only a part of the investigation of any case, and therefore errors of this sort are not likely to occur. The blood picture in Hodgkin's disease often closely resembles that of a post-infective state, but the clinical picture is almost certain to be sufficiently different. The following example of a case of lymphadenoma will show the similarity:—

Leucocytes, 7300	Eosinophils, 6 per cent
Neutrophils, 49 per cent, of which 1 per cent were of young type, 10 per cent were band forms, and 38 per cent were mature	Basophils, nil
	Lymphocytes, 39 per cent
	Monocytes, 6 per cent

It is not possible to lay down rigid criteria on which to base a prognosis in cases examined by these means, but some generalizations are of value, although they all require amplification by personal experience, and sometimes modification on clinical grounds. It has been my experience that as a rule a prognosis based on continued hæmatological examination is best not changed because at the moment the patient's clinical state does not seem to correspond: no definite opinion of the result of a case can be formed on one examination except in extreme examples. One record here should suffice. The case was one on which appendicectomy had been performed some eight months before the onset of the illness here described, which was at first supposed to be septicæmia of unknown origin. The blood picture was as follows:—

Leucocytes, 15,000	Eosinophils, nil
Neutrophils, 89 per cent, of which 43 per cent were young forms, 40 per cent were of band type, and only 6 per cent of mature cells	Basophils, nil
	Lymphocytes, 7 per cent
	Monocytes, 4 per cent

Here was a case with a very extreme degree of shift to the left of the neutrophils; the alteration was so great as to leave little doubt that recovery was impossible. A clinical diagnosis of subphrenic abscess was now made and the

patient was submitted to operation, when the abscess was found and dealt with. For the first three or four days clinical progress was good, but then the patient rapidly became worse, and died on the tenth day with a blood picture as follows :—

Leucocytes, 3600	Eosinophils, nil
Neutrophils, 93 per cent, of which 61 per cent were young forms, 30 per cent were of band type, leaving only 2 per cent of mature cells	Basophils, nil
	Lymphocytes, 2 per cent
	Monocytes, 5 per cent

There seems to be little doubt that here is an example of a case in which the formative tissues were so gravely injured that recovery was impossible because the defensive mechanism had been too greatly altered.

The following rules can be regarded as indications which will correspond accurately in almost every case to the course of an infective process :—

1. Slight neutrophilia with very little nuclear shift and with persistence of eosinophils is of good significance, and may not indicate a pathological state at all ; e.g., such a condition occurs in pregnancy, where, however, the percentage of eosinophils may drop without any appreciable fall in the absolute numbers of this type of cell ; this applies mainly to the later months of gestation. The following figures were obtained in the seventh month of pregnancy in a woman who had already borne two children and who appeared healthy :—

Leucocytes, 7600	Eosinophils, 3 per cent = 228
Neutrophils, 77 per cent = 5852 (of these 3 per cent were young forms, 11 per cent were band types, and 63 per cent were mature)	Basophils, 1 „ = 76
	Lymphocytes, 15 „ = 1900
	Monocytes, 3 „ = 228

Here there is slight shift to the left, but the absolute number of eosinophils is still within normal limits.

2. Slight or well-marked leucocytosis with definite nuclear shift of moderate degree (not more than 4 per cent of young forms and 12 per cent of band types), decrease of eosinophils, and slight decrease in the number of lymphocytes indicate a condition in which further examinations would be necessary before a prognosis could be given, although there could be no doubt of the presence of infection.

3. High leucocytosis with great shift to the left tending to progress in the same direction, with very great decrease or even disappearance of eosinophils and reduction of lymphocytes, is indicative of a grave condition, which may, however, still be recoverable. It is particularly when the young forms are in excess of those of band type that the prognosis is grave.

4. Recovery does not occur in those cases in which there is progressive fall of the total number of leucocytes with an extreme degree of shift to the left, total absence of eosinophils, and well marked lymphopenia.

5. Progressive eosinopenia with rising leucocytosis is never of good significance, unless

6. There is reappearance of the eosinophils and fall of the neutrophils, with reversion of the nuclear picture to normal, together with rise of the lymphocytes. It is clear that (5) represents the blood picture at the onset of an infection, and (6) the changes as it is overcome.

7. The development of lymphopenia during long-continued leucocytoses is of bad significance.

8. Sudden fall of lymphocytes in association with increasing neutrophilia and progressive nuclear shift to the left is of very grave significance, as is also a sudden fall of lymphocytes occurring during the course of a progressive decrease of the total number of leucocytes.

9. Lymphocytosis following neutrophilia, and accompanied by progressive passage of the nuclear shift towards normal and by eosinophilia, indicates recovery.

It is now necessary to speak briefly of the theoretical considerations relating to leucocytosis, because without such a discussion it is not possible to understand the principles underlying the interpretation of blood pictures.

The normal number of leucocytes in the circulating blood must represent the result of balanced processes, viz., production in the various formative organs and destruction at the periphery. In health, there seems to be but little variation in the intensity of these processes, and therefore the extreme of normal variation in number is not great. Arneth contends that the variations occurring in pathological conditions are the result of similar processes altered either by excessive production or by excessive destruction. Greatly increased production with only slightly increased peripheral destruction would result in leucocytosis with shift to the left of the neutrophils. Great peripheral destruction with only slightly increased formation in the marrow would manifest itself in leucopenia with nuclear shift to the left. Those infective states in which the total number of leucocytes is normal could be explained by the assumption that the increased formation is balanced by the excessive destruction; in such a state there would obviously be well-marked nuclear shift. Arneth's view, therefore, implies that every increase in the number of immature cells in the circulation must represent an increased and truly regenerative activity of the marrow; this conception is doubtless often in conformity with the known facts, but cannot be accepted for every case. Examples of leucocytosis not associated with increased peripheral destruction are seen in moribund persons where all types of marrow-cell are found in the circulation, in cases of metastatic tumours of the marrow, and in leukaemia. A blood picture with many immature neutrophils may arise as a result of infections which partially inhibit marrow function, so that maturation of the nuclei into the polymorphous form is delayed; in such a case many band forms may appear in the blood, to the partial exclusion of segmented types. It might be supposed that such a state was due to emigration of the ordinary immature neutrophilic cells; but this view is contradicted by examination of the marrow itself, because there is great increase in the number of cells with band nuclei at the expense of all other sorts of neutrophilic cells, i.e., inhibition of nuclear metamorphosis has occurred at a stage earlier than that of real segmentation; such a state might well be termed degenerative shift to the left. It has already been mentioned that normally the cells with lobulated nuclei are derived mainly from pre-existing granular cells with round nuclei (myelocytes), and that only a small percentage arises from the original ancestral form (the non-granular myeloblast), which is much more active in embryonic life

but is scanty in normal adult bone-marrow. Very long-continued infections are often associated with great increase in the number of myeloblasts in the marrow, with concomitant decrease of myelocytes. Leucocytosis with extreme degrees of shift to the left may be present in such cases; it seems almost certain that here the neutrophilic cell must be formed from its original ancestor, i.e., from a cell a stage earlier than that from which it normally arises. This fact may account for the predominance of band types in the blood, because the process of formation has started a definite stage earlier, and there has been insufficient time for the normal degree of maturity to be reached.

The conception of leucocytosis must be a mixed one; there is regenerative activity of the marrow, as is shown by the increase in the absolute number of neutrophils, but there is also in many cases evidence of degenerative change such as the presence of a number of immature cells greater than that normally present in the formative tissue. A leucocytosis almost entirely dependent upon the activity of an injured marrow is therefore possible, and such a condition is represented in *Figs. 12 and 13*, where at the end of life only immature cells were present in the blood. It is probable that in all cases there is a mixture of the two factors, viz., regeneration and degeneration.

The preceding part of this paper has dealt with hæmatology from the most usual aspect, viz., the changes occurring in the peripheral blood; but the key to such alterations is naturally to be found in the formative tissues, which are very cursorily dealt with in the second part of this communication. The structure of the bone-marrow will receive only passing attention here, because there is little new to write on the subject. Recent work on the finer histology of the lymphatic tissues in general has done much to clarify our conceptions of the histogenesis of many pathological states, and therefore the greater part of the available space will be devoted to it.

THE RETICULO-ENDOTHELIAL SYSTEM. ¹

It is neither possible nor desirable to review the literature of this subject in detail; it has been done recently both by Aschoff and by Schittenhelm.

It has already been mentioned that Aschoff and Kiyono claim to have shown that some at least of the monocytes are derivatives of a third cytopoietic system. This reticulo-endothelial tissue is not admitted as the parent tissue of the monocyte by all writers, but its existence cannot be questioned. In normal circumstances only certain well-defined groups of cells in the body will stain with injected dyestuffs such as Indian ink—e.g., the inter-follicular cells of the spleen, the Kupffer cells of the liver, etc. It is to the whole series of cells capable of taking up into their cytoplasm such dyestuffs that the name reticulo-endothelial system is applied. It is a striking fact that the particles of stain are found lying inside the so-called endothelial cells as well as in the adjacent reticular cells (reticular phagocytes). It is possible by special histological methods to demonstrate that the fibres of these reticular cells really run through the substance of the 'endothelial' elements (Downey). With this method it is possible to see that the walls of the channels of lymphatic glands are lined partly by 'endothelial' cells through which run fibrils, and partly by

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Hodgkin's disease is a condition with extraordinary histological changes, which have received a large number of explanations, and to-day it is popular to regard it as being a 'lymphogranulomatosis', i.e., a disease in which the essential pathological change is one affecting lymphatic tissue proper. It is clear that there are very many histological differences between such obvious proliferations of lymphatic tissue as lymphatic leukæmia and Hodgkin's disease. It is much easier to mistake a hyperplastic lymphatic gland from the vicinity of a focus of chronic irritation for one from a case of lymphadenoma than to confuse the latter with lymphatic leukæmia. *Fig. 16* shows hyperplasia of the 'endothelium' of a lymphatic gland, and it is easy to understand how further proliferation of this tissue would obliterate all the normal arrangement of the organ. The figure also shows how diffuse is the arrangement of reticulo-endothelial tissue in lymphatic tissues; this is made out only with difficulty in normal glands.

It is difficult in a normal gland to realize how widespread is the reticulo-endothelial tissue, but in the present specimen it is clear that endothelial cells are diffusely distributed throughout the lymphatic tissue. This diffuse cell system is here regarded as being the morphological basis of the lesion of lymphadenoma. The specimen was taken from a gland in the vicinity of a chronic gastric ulcer.

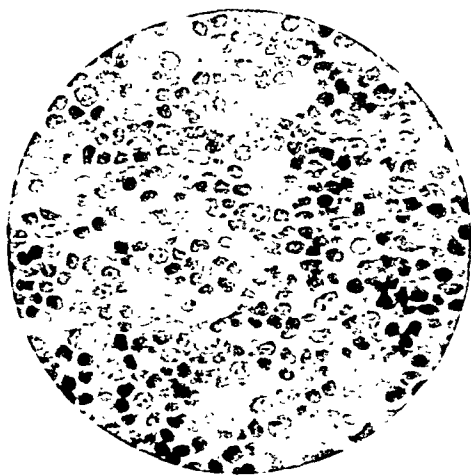


FIG. 16.—Diffuse 'endotheliosis' of lymphatic gland. ($\times 450$.)

Histological examination of the lesions of Hodgkin's disease shows the presence of a great variety of cells, most of which bear little or no resemblance to the cellular constituents of normal glands, just as the arrangement is much less orderly than in health. Complicated explanations of these histological changes have often been suggested, but many objections have been found to them all. The very salutary clinical habit of avoiding multiple diagnoses whenever possible has been too much neglected in most of the explanations of the histogenesis of lymphadenoma. It has been supposed that all sorts of tissues were proliferating at the same time, viz., endothelium, lymphocytes, connective tissue, and even some unknown cells which give rise to the giant cells so typical of the disease. Such a series of explanations is deplorable when the malady is regarded as being an infective one, but when it is classified with the neoplasms it is untenable. It has already been pointed out that the bone-marrow normally produces a great variety of cells, but when called upon for an unusually great effort in the production of any one type its activity in giving rise to the others is much decreased. If a single section of normal bone-marrow were examined, it would be impossible even to guess at the close inter-relationships of the cells there seen. These facts make it obvious

that the great variety of cells seen in lymphadenomatous lesions is no good reason for presuming that they are not derived from a common ancestor. Such a monophyletic view as to the origin of the lesion presents one distinct difficulty in that a proliferation of reticulo-endothelium would not account for the lymphatic hyperplasia seen in the early stages.

It is probable that the increase of lymphocytes is due to the irritation of the proliferating reticulo-endothelium which fills all the interstices of the tissue; but it is not impossible that the lymphocyte itself is a derivative of this diffuse system of cells. If lymphadenoma be regarded as a disease affecting the reticulo-endothelial system, one is immediately presented with an explanation involving only one tissue, which is so widely diffused throughout the affected organs that it is only rational to expect normal structures to be distorted and even obliterated very early. The late stages of the lesion show disappearance of many of the cells and replacement by an almost non-cellular tissue, which can only be reticulum; it is quite certainly not ordinary fibrous tissue. One is still left to find an explanation of the giant cells, which are so characteristic a feature of the lesions. A suggestion as to their genesis can be found by comparison with other maladies known to affect essentially the reticulo-endothelial system. Brill and Mandlebaum have been able to show that the large cells in the spleen and other tissues in cases of Gaucher's disease belong to the reticulo-endothelial system, and this is a lesion in which giant cells are quite common. It is even more important to realize that giant cells closely resembling those occurring in lymphadenoma are occasionally seen in glands subjected to chronic irritation, so that there can be little doubt that the lymphadenoma cell is yet another manifestation of the activity of reticular tissue. In brief, the lesion of lymphadenoma can be regarded as one affecting the reticulo-endothelial tissue, and it is possible to distinguish three more or less distinct phases of the process: (1) Proliferation of the reticulum throughout the affected gland with consequent distortion of its normal arrangement, excess of lymphocytes and of 'endothelial' cells; (2) Proliferation of reticulum with production of 'endothelial' cells and an increased amount of fibrillar tissue, but with reduction in the number of lymphocytes; (3) Proliferation of reticulum with production of large numbers of fibrils and of very few cells.

The possibility of dividing the process into phases is not surprising when it is realized that manifestations of any one phase may occur in other conditions, although the whole series is necessary for the diagnosis of lymphadenoma. A large production of 'endothelial' cells is not uncommon in tuberculosis (*Fig. 17*), and sometimes in other chronic infections; the so-called chronic irritative hyperplasia of lymphatic glands is the most obvious example of this type. In this lesion there is ample evidence that, when the parent tissue is performing one function to excess, its other activities are curtailed; e.g., in such chronic hyperplasia there is defective lymphocytopoiesis and practically no reticulosis but excess of endotheliosis. The mixture of processes in Hodgkin's disease must therefore be apparent rather than real, i.e., the variety of cell types and the reticulum are not produced by the parent tissue at the same time, but represent successive changes. *Figs. 18, 19, 20* show various stages and features of the lesion.

I have previously²⁷ suggested this idea of Hodgkin's disease as a reticulo-endotheliosis, and the view has been attacked by Sir H. D. Rolleston on the ground that, if the idea was correct, there should always be involvement of the Kupffer cells of liver and spleen. My contention is that the Kupffer cells are always affected when the spleen and liver are involved in the disease, but I do not suggest that lymphadenoma is a malady always affecting all the reticulo-endothelium of the body. The upholders of the view that Hodgkin's disease is a lymphogranulomatosis are not expected to be able to demonstrate that all the lymphatic tissue of the body is affected at the same time in every instance.

Other maladies have also been investigated from the point of view of the reticulo-endothelial system. *Gaucher's disease* is now usually admitted as being a lesion of this tissue, but it is interesting to understand how this view has been reached. Some of the conceptions as to the nature of the large cells typical of the disease are simply of historical interest, e.g., the teaching of Gaucher that the cells were epithelial—a view which was also shared by Picou and Ramond. Collier described the characteristic elements as being 'endothelioid'; Cornil noted that the cells resembled those seen in hyperplasia of lymphatic glands, and called attention to the fine connective-tissue framework, which he regarded as being the result of reticular overgrowth. Bovaird was even nearer than Cornil to a conception of the reticulo-endothelial character of the affected tissue, in that he described large alveoli separated from one another by thin lines of connective tissue from which nucleated cells projected.

Brill, Mandlebaum, and Libman describe the essential change as one affecting the endothelial lining of the pulp spaces, or more properly 'venous capillaries', of the spleen. Schlagenhauser took the position that the reticulum was the affected tissue, and that the large cells were not endothelium, but were swollen reticular elements. Brill, Mandlebaum, and Libman, in a later communication, state that the affected organs "show the presence of large cells with small nuclei and a peculiar hyaline cytoplasm, which arise from the endothelium or normal reticulum". Mandlebaum and Downey come very near to the view that Gaucher's disease is a special form of lesion affecting reticulo-endothelium in saying "that the characteristic cells of Gaucher's disease are derived from the reticular apparatus of the hæmatopoietic system.



FIG. 17.—Tuberculosis in lymphatic gland. In the centre of the field is a giant cell, around which is much lamellated, non-cellular 'fibrous' tissue. Here, as in lymphadenoma, the reparative tissue seems to be reticular rather than fibroblastic in origin. The extremely close relationship of the reticular fibres to the scanty epithelioid cells is obvious in the lower part of the picture. ($\times 750$)

but the possibility of an additional origin from the endothelium of the venous sinuses in the spleen cannot be denied".

It is now clear that it has never been possible to make sharp distinction

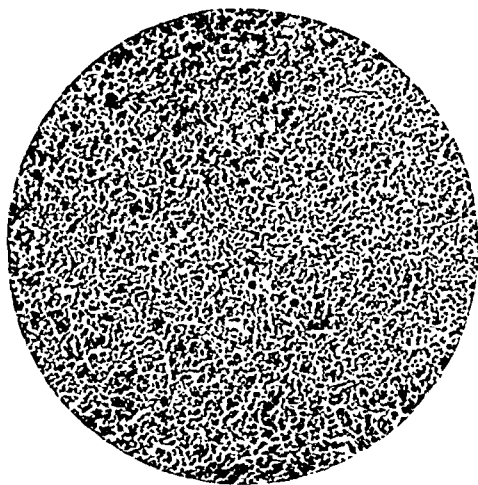


FIG. 18.—Lymphadenoma in lymphatic gland. The complete disorganization of the normal arrangement of the gland tissue is immediately obvious, as is furthermore its partial replacement by polymorphic cells. The only tissue so widely and completely permeating the lymphatic tissue as to be able to produce such disarrangement is that belonging to the reticuloendothelial system. ($\times 130$.)

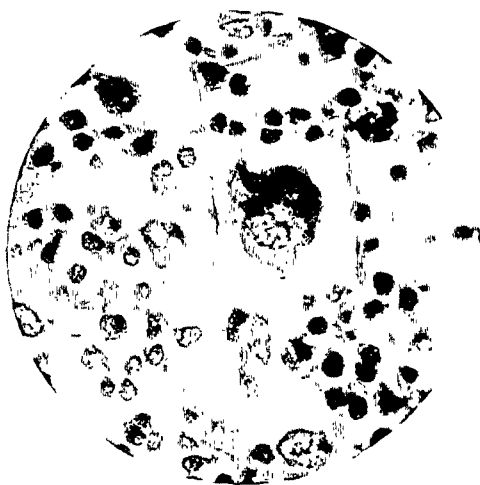


FIG. 19.—Lymphadenoma in lymphatic gland, showing the presence of a variety of cell types at a much more advanced stage of the lesion than that shown in *Fig. 18*. ($\times 540$.)

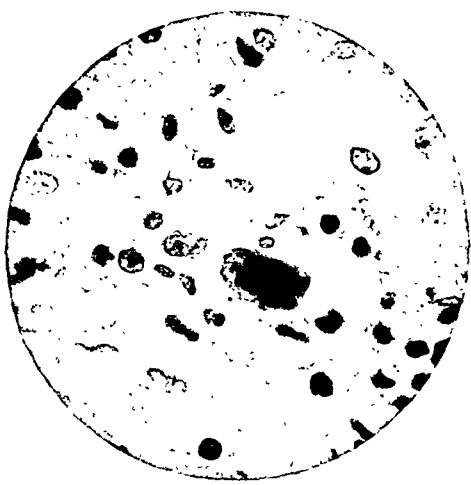


FIG. 20.—Lymphadenoma in lymphatic gland. The characters of the 'lymphadenoma cell' are here seen, and the diffuse deposition of non-cellular reticulum is also obvious. ($\times 540$.)

between the reticulum and the endothelium of hæmatopoietic tissue, and in the light of more recent ideas as to their relationships it is obvious that this depends upon the interchangeability of the two structures. *Fig. 14* shows

the typical appearances from a case of Gaucher's disease. The usually slight involvement of the Malpighian bodies doubtless depends upon the small amount of reticulum normally present in this region.

It is convenient here to describe some of the peculiarities of the intra-splenic circulation, because this is of interest in relation to the reticulo-endothelial system as well as to the causation of the site of metastases in this organ. *Fig. 21* shows the course of the vessels in the spleen, as determined both by serial section of the injected organ, and by tracing out the course of the blood-channels in congested specimens. It will be obvious from the diagram that any one red or white corpuscle can pursue one of two courses, viz., either through the continuous channel to emerge through the venule, or through the short channels in the substance of the Malpighian body to enter the meshes of the pulp, from which it will be

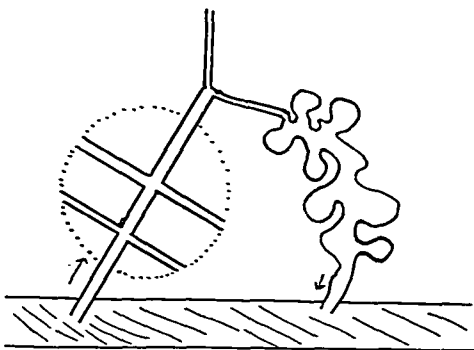


FIG. 21.—Diagram of the course of intrasplenic blood-vessels.

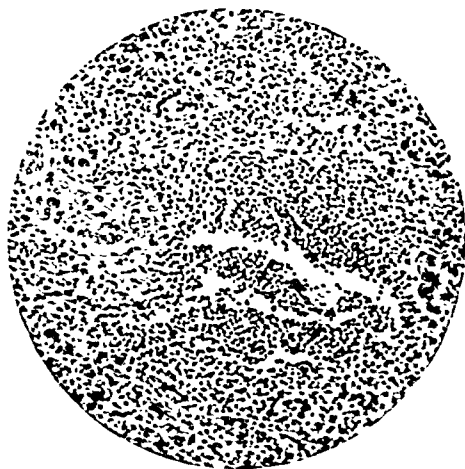


FIG. 22.—Metastases of liver-cell carcinoma in the spleen. Small collections of tumour-cells are lying in incomplete channels at the edge of a Malpighian body, which is the site at which they are to be expected. (Photograph from a specimen kindly given by Dr. D. Cappell, of Glasgow.) ($\times 135$.)

is probably due to the large size of most neoplastic masses preventing them from entering the pulp via the Malpighian channels; the propulsive action of the contractions of the organ may also facilitate onward passage of the tumour-cells.

gathered up into the venous channels unless it is first engulfed by the 'endothelial' cells lining the pulp spaces. The factors governing the number of corpuscles following each course are quite unknown, but size might well be supposed to be of importance; there is no doubt that red corpuscles of abnormal dimensions are destroyed in the spleen in such diseases as pernicious anæmia and acholuric family jaundice, i.e., they must pass out of the main blood-stream into the pulp spaces. Other cellular elements of unusual size might also be expected to lodge in pulp spaces, and *Fig. 22* shows a small mass of epithelial cells derived from a carcinoma of the liver lodged in a pulp space at the edge of a Malpighian body. The rarity of metastases in the spleen

It is perhaps doubtful whether the peculiar malady known as *Banti's disease* should be considered at this point, but its great surgical interest, and the possibility that it is related to the diseases just discussed, entitles it to some description. There is really no validity for the view that this malady has no separate existence, but is simply a hotch-potch of misunderstood splenomegalies; there can be but little doubt that Banti's idea that this is primarily a splenic lesion is a correct one, i.e., that the disease is a sort of 'hypersplenism'. It must be recollected that anæmia is one of the characteristic features of the disease, although no hæmolysin has ever been demonstrated; the blood destruction must therefore be a cellular rather than a humoral one. It is also important to note that 'fibrosis' (*Fig. 23*) is the last stage of the histological lesion in the spleen, i.e., it is quite probable that this is a 'reticulosis'.

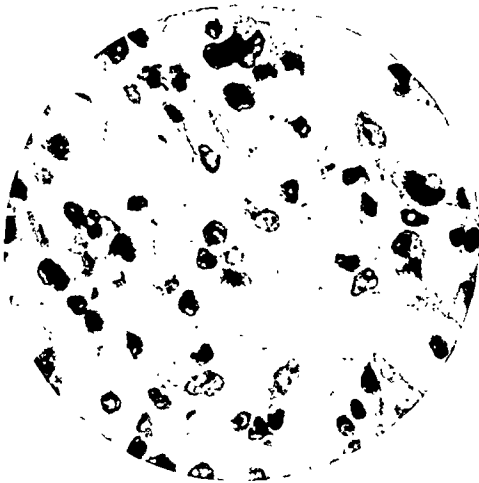


FIG. 23.—Spleen in Banti's disease. It is clearly seen that the so-called fibrosis of this disease is not cellular in character. ($\times 360$.)

Gye and Purdy have shown that colloidal silica is a poisonous substance. They demonstrated that it was possible to cause alterations of the Kupffer cells of the liver with suitable dosage of this substance; repair of this lesion was by fibrosis, with development of a typical multilobular cirrhosis of the liver. Another form of cirrhosis

also is known to be associated with injury of the Kupffer cells, viz., hæmochromatosis (bronzed diabetes). It would seem possible to correlate the reticulo-endotheliosis of the spleen with the multilobular cirrhosis of the liver, which is so characteristic of the late stages of Banti's disease in the light of these observations. Whether the appearance of proliferation of the reticulum in the liver in this malady depends upon transference of cells from the spleen to the liver, or whether upon the action of some noxa with greater affinity for splenic than for hepatic reticulum, cannot be determined. It is clear that the early stages represent involvement of the splenic reticulum alone, whereas the late stages, which are less susceptible of cure by splenectomy, differ in being a comparatively generalized disease of the reticulo-endothelial system.

METASTASES IN THE HÆMATOPOIETIC TISSUES.

Deposits of malignant tumours in the spleen have already been discussed. There can be but little purpose in a description of metastases in lymphatic glands, because their genesis has been worked out so very completely by Sampson Handley. It is here only necessary to refer to deposits of malignant tumours in the bone-marrow.

A summary of the evidence that such deposits reach the marrow via the blood-stream is all that is necessary here, because a detailed review of the available facts has been given elsewhere (Piney^{21, 22}).

Deposits of malignant tumours in the long bones occur first near the upper ends, particularly in the femora and humeri, but much more rarely in the distal bones of the limbs. This site of election is supposed by Handley to result from permeation of lymphatics running centrifugally in tendinous and muscular attachments. If this view were correct, it should be usual to find that a tumour had eroded into the osseous tissue from without; but this is indeed a rarity. Almost invariably one observes that metastatic tumours occur inside the medullary cavity, often without any sign of even the slightest erosion of adjacent bone. It might, therefore, be supposed that



FIG. 24.—Metastasis in the bone-marrow of the femur.

the lymphatics of bone had been permeated by tumour-cells which so reached the bone-marrow and then spread on in that tissue. This idea is incompatible with the frequently demonstrated absence of lymphatic channels from the marrow²³; deposits via the lymphatic channels could at the furthest reach the inner surface of the compact bone.

There is one very obvious difference between the contents of the medullary canal in the upper and the lower parts of the proximal long bones, viz., the former is composed of cellular marrow, while the latter is purely fatty in the adult. It seems certain that emboli could more easily be caught in the complex blood-channels of the red marrow than in the simple capillaries and arterioles of the fat. It is possible, in some cases of

metastasis in the marrow, to demonstrate that the tumour-cells lie inside blood-vessels (*Fig. 24*).

The presence of a growing mass in the hematopoietic marrow leads to definite changes in the morphological composition of the blood.^{21, 22} The condition is of great interest, because its occurrence shows how difficult it may sometimes be to differentiate between leukæmia, an intense myeloid reaction, and metastatic carcinoma of marrow from the blood picture alone. The whole of the marrow is disturbed, so that the blood shows evidence of disorderly emigration of immature red corpuscles and cells. It must be realized that many nucleated red cells and immature leucocytes may appear in the blood in such conditions without there being any anæmia to account for the change, although it is more usual to see some reduction both of red corpuscles and of hæmoglobin.

One case will illustrate the points quite clearly, but not all the cases show a high colour index as did this one. The clinical diagnosis of this case was pernicious anæmia, and the blood showed:—

Red corpuscles, 3,000,000	|	Colour index, 1.3
Hæmoglobin, 80 per cent.	|	

The condition was therefore compatible with a diagnosis of pernicious anæmia if only the state of the red corpuscles was considered.

Leucocytes, 13,500.

This is a much higher number than is ever seen in uncomplicated pernicious anæmia.

The differential examination of stained films showed:—

Neutrophils, 60 per cent, of which 6 per cent were myelocytes, 8 per cent were young forms, 20 per cent were band forms, and 26 per cent were mature polymorphonuclears		Eosinophils, 1 per cent Basophils, nil Lymphocytes, 19 per cent Monocytes, 15 per cent Myeloblasts, 5 per cent
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While counting 1000 leucocytes, 507 nucleated red cells were seen.

There is thus in this case an extreme degree of shift to the left of the neutrophils, so that even myeloblasts have appeared in the circulation. The gross changes in the distribution of the leucocytes and the very large number of nucleated red cells made it obvious that the diagnosis of pernicious anæmia should be changed for a tentative one of secondary deposits in bone-marrow. At autopsy, a primary growth was found in the stomach, and metastases were found in the vertebral column and in the upper ends of both humeri and both femora, i.e., in the usual sites. It is particularly important to correlate the clinical findings with the hæmatological ones in these cases, because a similar 'leukæmoid' blood picture may occur as a result of widespread septic infection of the medullary cavity, as is shown by the following case of a compound comminuted fracture, which was infected with both aerobic and anaerobic bacteria:—

Leucocytes. 65,000	|	Eosinophils, 1 per cent
Neutrophils, 81 per cent, of which 3 per cent were myelocytes, 29 per cent were young forms, 13 per cent band forms, and 36 per cent mature polymorphonuclears	|	Basophils, nil
	|	Lymphocytes, 5 per cent
	|	Monocytes, 1 per cent
	|	Myeloblasts, 12 per cent

While counting 1000 leucocytes, 100 normoblasts were seen. It must be realized that the chance of development of such a leukæmoid blood picture as a result of infection of the marrow is limited by the comparatively small areas containing red marrow in the adult.

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SPONTANEOUS DISLOCATION OF THE HIP.*

BY. R. WATSON JONES, LIVERPOOL.

SPONTANEOUS dislocation of the hip-joint, having a frequency undoubtedly greater than that of traumatic dislocation, and producing equally crippling results, has received far less attention than the latter condition. This study was based on a series of 5908 patients, of whom 27 were treated for spontaneous dislocation of the hip (i.e., all non-traumatic acquired dislocations), the incidence therefore being 1-219. In the same series there were only 2 cases of traumatic dislocation—an incidence of roughly 1-3000; so that whether spontaneous dislocation is to be regarded as rare or not, it is undoubtedly less rare than traumatic dislocation.

The cases include dislocations resulting from paralyses, both upper and lower neuron lesions, and from infections and degenerations of the hip-joint, of various types. One has preferred to class these cases together under the heading of 'spontaneous dislocation', avoiding the use of the term 'pathological dislocation', because one believes that the pathology of the condition is essentially the same whether it be due to paralysis or infection. The cases may be classified as follows:—

Table I.—CLASSIFICATION OF CASES.

<i>Dislocation from Muscular Paralysis:—</i>				
Anterior poliomyelitis	..	..	6 cases	
Spastic paraplegia	..	..	1 case	— 7
<i>Dislocation from Acute Arthritis:—</i>				
Smith's septic arthritis	..	..	3 cases	
Pneumococcal arthritis	..	..	3 „	
Arthritis of exanthemata	..	..	2 „	
Pyæmic arthritis	..	..	1 case	
Arthritis of doubtful origin	..	..	3 cases	
Acute tuberculous arthritis	..	..	2 „	— 14
<i>Dislocation from Chronic Arthritis</i>	..	..	none	
<i>Subluxation from Chronic Arthritis:—</i>				
Tuberculous arthritis	..	..	2 cases	
Osteo-arthritis	..	..	3 „	
Hæmophilia	..	..	1 case	— 6
				27

Reference is also made to many others of this series of patients in whom similar diseases had not resulted in dislocation, in order thereby to establish more definitely the factors responsible for the condition.

* Paper read at a meeting of the Liverpool Medical Institution, January, 1926.

PATHOLOGY.

It is taught that three factors combine to maintain the stability of joints—the shape of the bone-ends, the resistance of intra- and extra-articular ligaments, and the action of the surrounding muscles. But of these there is no doubt that muscular action is of primary importance. The shoulder-joint is stable in spite of its lax capsule, and in spite of the fact that the bone-ends are shaped for mobility and not stability. The crucial ligaments of the knee-joint are strong, yet they readily stretch and allow of subluxation when the quadriceps is paralysed and the hamstrings persist; or, conversely, they may stretch and allow of the production of genu recurvatum when the hamstrings are paralysed and the quadriceps is unopposed.

Similarly, in the hip-joint, although the shape of the bones is of the enarthrodial type, and although the capsular ligament is strong, the action of the muscles surrounding the joint is of supreme importance in the maintenance of its stability. It is one's endeavour to show that the pathological changes resulting in spontaneous dislocation are essentially muscular derangements, and not lesions of bone or ligament. In the first two groups of cases—the paralytic dislocations—this is obvious, the only lesion being a muscular paralysis. In those cases of dislocation following arthritis, although there may be bone destruction as well as disturbance of muscular balance, such bone destruction is not the essential factor in the displacement, and dislocation can occur without it, providing that the typical muscular derangement exists.

ANTERIOR POLIOMYELITIS.

An investigation of the six cases due to infantile paralysis shows that in all of them there is a fairly severe flexion-adduction contracture. The extensor of the hip (*gluteus maximus*) is always paralysed, and most of the abductors are paralysed (*gluteus medius* and *minimus*, *tensor fasciæ femoris*, and *sartorius*). The strong adductor muscles, and the equally strong *iliopsoas*, are therefore unopposed, and by their unrestricted tonic activity pull the thigh into the flexed-adducted position, which is afterwards maintained by the adaptive muscle shortening which occurs. Brief notes of the cases are quoted, to support these facts.

Case 1 (Fig. 25).—M. L., female, age 8. Spine and both lower limbs affected. Paralytic scoliosis. Left lower limb: Paralysis of adductors and gluteus maximus; flexion contracture 70°; abduction contracture 60°; hip normal. Right lower limb: Paralysis of glutei, tensor fasciæ femoris, and sartorius; adductors and psoas active; flexion contracture 70°; adduction contracture 40°; dorsal dislocation hip.

Case 2.—F. R., female, age 21. Both lower limbs affected. Flail below hips. Right lower limb: Paralysis of adductors and paresis of psoas; abduction contracture 30°; hip normal. Left lower limb: Glutei paralysed; psoas and adductors intact; flexion contracture 60°; adduction contracture 30°; hip dislocated dorsally.

Case 3.—F. H., male, age 8. Right foot and left lower limb affected. Glutei paralysed, adductors paralysed (except sartorius); adductors fair power; iliopsoas intact; flexion contracture 70°; adduction contracture 20°; dorsal dislocation hip—easily reducible but unstable.

Case 4.—I. A., female, age 8. Both lower limbs affected. Right lower limb: Weakness of glutei with slight flexion contracture. Left lower limb: Paralysis of all

glutei and of tensor fasciæ femoris ; flexion contracture 80° ; adduction contracture 30° ; dorsal dislocation left hip.

Case 5.—F. M., male, age 13. Right lower limb affected, and left lower limb slightly. *Right lower limb* : Abductors and extensors of hip paralysed ; flexors and adductors intact ; flexion contracture 70° ; adduction contracture 30° ; dorsal dislocation hip.

Case 6.—H. J., male, age 23. Right abdomen and right lower lower limb affected. Gluteus maximus paralysed ; other glutei weak ; adductors weak ; iliopsoas intact ; flexion contracture 60° ; adduction contracture slight ; hip subluxated but not completely dislocated.

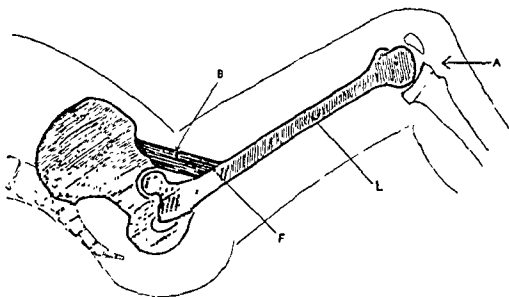


FIG. 25.—Diagram representing the existing theory of the mechanism of paralytic dislocation. It is assumed that a force (A), acting in the direction of the arrow, is assisted by a 'bowstring', the contracted flexors (B), a fulcrum (F), and the long lever of the femur (L). It is shown in the text that such a force is non-existent, and that flexion contracture alone does not cause dislocation.

The existing hypothesis of the mechanism of paralytic dislocation^{1,2} is based on the assumption that the gluteus maximus is alone paralysed and the flexor muscles are shortened. The attachment of the contracted flexors is regarded as a fulcrum and the length of the femur as a lever, so that force

FIG. 26.—*Case 1.* Paralytic dislocation of right hip due to infantile paralysis. Pelvic tilting is masking flexion-adduction deformity on the right, and flexion-abduction deformity on the left. The roof of the right acetabulum is well formed.



applied to the knee displaces the femoral head backwards out of the acetabulum (*Fig. 25*). A history of such force, however, is never elicited, and, moreover, flexion contracture in itself does not result in paralytic dislocation.

Fig. 26 is instructive on this point, where both hips are flexed to 70° .

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On the left this is associated with an abduction contracture and the hip is not dislocated; on the right the flexion contracture is associated with an adduction contracture and the hip is dislocated. The insufficiency of flexion in itself is shown in the following summary of all the cases of flaccid paralysis of the hip muscles in this series. The distribution of the paralysis in poliomyelitis is so capricious that a classification thus would be far too unwieldy. They are therefore classified according to the resulting deformity only.

Table II.—CLASSIFICATION OF 157 CASES OF FLACCID PARALYSIS OF THE HIP MUSCLES, ACCORDING TO THE DEFORMITY PRODUCED.

					CASES
Pure flexion	..	..	..	..	34
Flexion-abduction	..	..	..	..	20
Flexion-adduction	..	..	..	..	19
Adduction only	..	..	..	..	10
Abduction only	..	..	..	..	10
No contracture—					
1. Flail hip	..	..	..	..	28
2. All weak, but none paralysed	..	..	..	..	11
3. Only flexors paralysed	..	..	..	..	8
4. Muscles paralysed, but deformity prevented	..	..	..	..	17

A flexion deformity was therefore present in 73 cases. Adduction was associated with flexion in 19 cases, and in only 9 of these was the deformity severe. Of these 9 cases there were 6 with paralytic dislocation of the hip, and these were the only dislocated hips in the whole series of 157 cases.

Arguing from this fairly extensive series, it would appear clear that an unopposed activity of the flexors and adductors of the hip is the cause of paralytic dislocation. The mechanical explanation of this is readily forthcoming. In this position the head of the femur is only partly covered by the postero-inferior rim of the acetabulum—its shallowest rim—so that there is very little bony obstacle to dislocation.* The greater part of the head is in contact with the capsular ligament, which is also comparatively weak at this part (ischio capsular fibres). Moreover, the capsule provides no greater resistance to muscular activity here than do the crucial ligaments in the knee-joint, as pointed out earlier.

Fairbank³ has reported a case of a practically flail hip in which there was reducible subluxation (though not complete dislocation). Remarking on the rarity of paralytic dislocation, he points out that, in the few cases he has seen, there has been always a paralysis of the abductors with active adductors, and can only suggest in this case an habitual postural adduction as the cause of the displacement. Apart from the indisputable possibility of the subluxation being 'pre-paralytic', the paralysis and the subluxation may not have been directly related as cause and effect. It is within reason that the flail character of the hip was simply a condition predisposing to a displacement due to a comparatively mild and forgotten trauma.

Elmslie⁴ believes that if complete paralytic dislocation occurs at all it is a most rare condition, the more common malady being subluxation. This

* This fact may be confirmed by articulating the dry bones. If the femur is flexed to 80° or 90°, an adduction of 30° is sufficient to send the head of the bone *gliding* over the posterior acetabular rim.

condition of subluxation is the first stage of all paralytic displacements, and, if the case is seen and treated at this stage, it is true it never goes any further.

However, in a subluxated hip there is nothing to prevent complete dislocation except the capsule, and if the case is neglected, this, as I have already shown, will stretch and allow complete dislocation to occur. The question, therefore, as to whether a paralytic displacement is a subluxation or a luxation is, I believe, mainly a question as to whether treatment is adopted early or late, and the results of this investigation show that, in the past at least, complete dislocation has been the more frequent complication. The distribution of the paralysis may also effect the completeness of the dislocation. Flexion alone may produce subluxation similar to the temporary subluxation which frequently occurs during manipulation of the hips under anæsthesia when they are fully flexed. However, as in *Case 6*, the displacement never becomes complete unless the flexion deformity is associated with overaction of the adductors.



FIG. 27.—*Case 7*. Spastic paraplegia. Photograph to show flexion contracture on both sides, with adduction contracture best seen on the left.

SPASTIC PARAPLEGIA.

Although dislocation of the hip in infantile paralysis is undoubtedly rare (1-1000 orthopædic cases in this series), the similar dislocation in spastic paraplegia is of even greater rarity (1-6000).

Case 7.—(*Figs. 27, 28*) P. P., female, age 12. Paralysis first noticed when 9 months old. Spasticity both lower and upper limbs. Knee-jerks ++, ankle and patellar clonus, Babinsky - extensor response, plastic tonus ++, anarthria, mentality fair, severe flexion-adduction spasm and contracture of both hips. When first seen in the outpatient department, left hip dislocated dorsally, right hip normal. When admitted to wards this year, right hip also dislocated.

There is therefore no doubt as to the cause of the dislocation. The right hip was shown clinically and radiographically to be stable and not displaced, and six months later, without accident or disease, the same hip is dislocated.



FIG. 28.—Skiagram of case shown in *Fig. 27*. Dislocation of left hip. Six months later the right hip was also dislocated. Both were successfully reduced by manipulation.

and six months later, without accident or disease, the same hip is dislocated.

Since the deformity of the hip in spastic paraplegia is again one of flexion and adduction, the mechanism of the luxation is strictly comparable with that already discussed under poliomyelitis. However, in contrast with the frequency of flexion deformity of the hip in poliomyelitis, due to the very common paralysis of the glutei, flexor spasm is rarely severe in spastic paralysis, and this accounts for the relative rarity of paralytic dislocation in the latter condition. Endless cases could be quoted to show that adduction spasm without flexor spasm is insufficient to dislocate the hip. Moreover, as in infantile paralysis, the converse is true—flexion unassociated with adduction does not cause spontaneous dislocation.

I have been unable to find in the literature any record of a similar case, but Mr. Elmslie has kindly supplied me with the notes of an unpublished case of spontaneous dislocation due to infantile spastic hemiplegia. The hip was known to be normal at birth in this child, and, as in the case just recorded, there was, in addition to the usual adduction deformity, a very severe flexion spasm and contracture.*

ACUTE INFECTIVE ARTHRITIS.

That acute infection of the hip is the most prolific source of true spontaneous dislocation is apparent from the classification above, 12 of the 27 cases being of this nature. Dislocation may complicate any acute arthritis of the hip, whatever the cause of the arthritis may be. Cases are recorded of dislocation in streptococcal,⁵ pneumococcal,⁷ influenzal,⁶⁻⁸ scarlatinal,⁹ and tuberculous arthritis,¹⁰ as in the cases recorded here. It is also said frequently to occur in the arthritis of typhoid fever, although there were no such cases in this series.^{11 12, 13}

There can be no doubt that, in this type of dislocation, destruction of the head of the femur and of the acetabulum may be a very definite predisposing cause. Choyce¹⁴ emphasizes the over-distention of the joint which may occur, with resulting laxity of ligaments. In a virulent destructive arthritis the joint may be so thoroughly disorganized that dislocation is inevitable, and this explains the frequency of the condition in acute infections. Such types of dislocation are seen in *Figs. 29 and 30*, where the usual shape of the bones is almost unrecognizable. Yet, on the



FIG. 29.—Case 17. Dislocation of left hip following acute arthritis, with marked destruction of femoral head and of acetabulum. During convalescence from the arthritis the child had an attack of infantile paralysis, which, by affecting the glutei, resulted in flexion and slight adduction contracture. Either condition alone was capable of dislocating the joint.

* Since writing the above notes, I have seen another case of displacement of the hip due to spastic diplegia in a man of 22. In this case there was a marked adduction contracture but very little flexion contracture, and the hip was only subluxated, not completely dislocated. This case strongly supports the suggestion that adduction in itself cannot cause complete displacement.

other hand, dislocation may occur in infective arthritis with practically no destruction of the head or acetabulum (*Fig. 31*). Moreover, dislocation may complicate non-suppurative arthritis of the hip.⁸



FIG. 30.—*Case 13.* Dislocation of the right hip following pneumococcal arthritis. The hip was very stable, and resisted all efforts at manipulative reduction.

Lamy,¹⁵ in reporting two cases following pneumococcal arthritis of the hip, points to the complete absence of acetabular deformity. He makes the somewhat improbable suggestion that the roof of the acetabulum is 'softened' though not destroyed, so that it cannot support the femoral head. The interesting point, however, is that in both cases the dislocation occurred quite suddenly during the acute phase, when there was marked flexion and adduction spasm. In all the cases I have examined the dislocation has occurred very rapidly, in the second or third week, when the infection is at its height and the muscle spasm greatest. There has always been a flexion-adduction deformity.

It is clear, therefore, that in all these cases, whatever the predisposing causes may be, the exciting cause of the luxation is muscular action, deranged as a result of muscle spasm and muscle atrophy being unequally distributed in different muscle groups. Arthritis of the hip, if untreated, almost inevitably results in flexion and adduction deformity, and it is this position which is most favourable for dislocation of the joint—the position which we have already found to be productive of paralytic dislocation.

CHRONIC INFECTIONS, ETC.

The last group of cases, including the less acute infections of the hip, shows that in this type of joint affection, although incomplete displacement or subluxation is not uncommon, true dislocation is very rare. Complete dislocation does occur occasionally in arthritis deformans,¹⁶ and of course in Charcot's arthropathy,¹⁷ but in chronic arthritis as a whole it is notably rare. This fact supports the view that muscular action is the most important factor in the dislocations of acute infective arthritis. There may be an equally severe destruction of bone in both types of case, and presumably also the capsule may be infiltrated and softened to a similar degree; but the muscle spasm is undoubtedly greater in the acute case.



FIG. 31.—*Case 11.* Dislocation of twenty-five years' standing due to acute arthritis. Note absence of bone destruction; the small femoral head is a result of non-development in accordance with Wolff's law. The patient complained of severe pain over the great trochanter, which prevented her lying on that side.

This suggested limitation of complete dislocation to the acute type of arthritis is well illustrated by the displacements of the hip due to tuberculous disease. Two of these were of a virulent and fulminating type, and the dislocation was complete. The other two cases were of the more slowly progressing type, and, although there was considerable bone destruction, the femur was only subluxated. These 4 cases were from a total of 91 tuberculous hips, the incidence of complete dislocation being therefore 1-45. In a total of almost 3000 cases of tuberculous disease of joints treated at the Institute Rizzoli, Vacchelli reports 750 cases of hip disease,¹⁸ with one dislocation in every 27 cases. Although some of these were central or intrapelvic dislocations, the frequency of posterior displacement in his cases is remarkable. In one's own experience the condition which arises more frequently is that of 'wandering acetabulum'—a condition to be distinguished from true dislocation—which ultimately terminates in ankylosis with a stable hip.

In osteo-arthritis there is a further factor concerned which renders the joint less liable to dislocation. Unlike the almost purely destructive process of tuberculous infection, the simultaneous formative bone activity results in 'lipping' and osteophyte formation, which undoubtedly assist in the stabilization of the



FIG. 32.—Case 25. Subluxation due to osteo-arthritis. Complete dislocation is prevented by the locking of osteophytes.

joint (Fig. 32). This, together with the absence of marked muscle spasm, makes dislocation a much less common complication than subluxation. From a total of 63 cases of osteo-arthritis of the hip there were, in this series, 3 subluxations and no dislocations. Max Page has recorded the details of 34 cases of osteo-arthritis of the hip, and one finds amongst them none with dislocation, but 2 with subluxation.¹⁹

The case of hæmophilic disease of the hips was a puzzling yet a highly instructive one. The existence of hæmophilia was beyond question, but the condition was complicated by

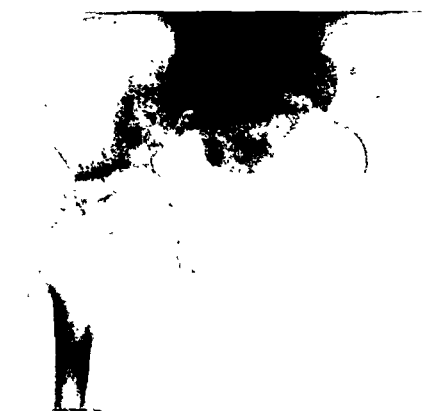


FIG. 33.—Case 27. Hæmophilic disease of hips. Subluxation on right, although there is practically no bone destruction. Left hip, in spite of bone destruction, is not displaced, because it is extended and slightly abducted.

the presence of tuberculous glands in the neck, which on one occasion underwent caseation and abscess formation requiring aspiration. Certain features, however, suggest that the true diagnosis was hæmophilic disease.

Case 27 (Fig. 33).—F. W., male, age 4. Complained of limping on left leg when age 2. On examination hips flexed and adducted. All movements painful and limited. Muscle spasm ++. Treated with weight-extension, and later left hip in plaster (the extension strapping caused excoriation of the skin, which bled persistently). Twelve months later, child still walking with flexion deformity and lordosis. Still flexion spasm and slight adduction spasm of both hips. Some days can stand, other days too painful (? fresh hæmorrhage). Again on extensions. Three months later, non-fluctuating lump over left hip (? abscess or hæmatoma); disappeared in ten days.

Whether the true diagnosis is hæmophilic or tuberculous disease, the instructive point is that subluxation has occurred on the right—the side with the least bone destruction, but the side on which muscle spasm has been least controlled. On the left most of the femoral head is destroyed, but the limb is fully extended and slightly abducted, and no displacement has taken place.

CLINICAL SIGNS AND DIAGNOSIS.

It will be readily appreciated from the pathology as already discussed that spontaneous dislocation is almost invariably posterior, the head of the femur riding upwards on the dorsum ilii.* The clinical signs are as a rule clearly those of a backward dislocation. The existence of real shortening, raising of the great trochanter, 'hollowing' of Scarpa's triangle, broadening of the perineum, telescopic instability, and Trendelenburg's sign, make a clear picture when associated with the diagnostic sign of palpation of the head of the femur on the dorsum of the ilium when the thigh is rotated.

Occasionally, however, the signs are modified. In long-standing cases when suppuration has occurred there is considerable 'scarring' and fibrous-tissue formation round the head, which increases the stability of the limb and minimizes the telescopic movement possible. In some cases there is bone proliferation and osteophyte formation (*see Fig. 30*), or the formation of a pseudarthrosis and 'false acetabulum', which make the limb quite stable.

There is a point of importance in the diagnosis of paralytic dislocation. It must be realized that where the glutei are paralysed and atrophied it is possible to feel through them the normal head of the femur rotating *in the acetabulum*, if the limb is flexed and the thigh rotated. I have at various times seen four cases diagnosed as paralytic dislocation where the X rays showed no displacement, and feel sure that this accounted for the error. I have, moreover, made the same mistake myself in a boy with a flexion contracture, and have subsequently realized and confirmed the source of error. Further support is given to the mistaken diagnosis by the considerable shortening which may occur in the paralysed limb as a result of atrophy and failure of development. Moreover, in cases where the hip abductors are paralysed Trendelenburg's sign may obviously be present, whether the hip is dislocated or not—the abductors of the hip being more important than the opposite abdominal muscles in producing pelvic tilting.

* The notes are on record²⁰ of one of Hilton's patients, in whom, following bilateral hip disease, there was a posterior dislocation on one side and an anterior (obturator) dislocation on the other. Since the case occurred in Hilton's practice in July, 1864, thirty years before Röntgen's discovery, there was no radiological confirmation of the clinical findings.

DIFFERENTIAL DIAGNOSIS.

It is of considerable importance, from the point of view of treatment, to distinguish spontaneous from congenital dislocation. Occasionally a child with a congenital hip dislocation suffers subsequently from an attack of poliomyelitis. The residual paralysis may be of the type which would cause paralytic dislocation, and the late diagnosis is difficult.

Fig. 34 is the photograph of a child admitted as a case of 'paralytic dislocation due to spastic paraplegia'. The diagnosis appears correct; the hip is obviously dislocated, and the paraplegia is severe. Nevertheless the skiagram (*Fig. 35*) shows the appearances typical of congenital dislocation, and the spastic paralysis is therefore a mere coincidence.

A boy of 15 years was examined, suffering from progressive muscular dystrophy, with severe wasting of the glutei, a flexion contracture of the hips, and a dislocation on the right. The dislocation, however, was not secondary to the myopathy, but was congenital in origin.



FIG. 34.—Severe spastic paraplegia with dislocation of right hip, thought to be paralytic in origin (note prominence of head of femur).



FIG. 35.—Skiagram of case shown in *Fig. 34*. In spite of the impossibility of securing a good skiagram in this case, it can be seen that the roof of the acetabulum is deficient, and the shape of the head of the femur suggests that the dislocation is congenital, not paralytic.

Again, suppuration may occur in the region of congenitally dislocated hips, and the appearances are those of dislocation due to suppurative arthritis—the 'pseudarthroses flottantes' of the French. I was fortunate in seeing a very excellent example of this in a child of 4. Twelve months previously abscesses had been opened in the groin and buttock, and during convalescence it was discovered that the hip was dislocated. Naturally the diagnosis made was dislocation secondary to acute arthritis of the hip. Yet one could not wish to

see a skiagram more typical of congenital dislocation than that shown in

Fig. 36, proving that the suppuration was a secondary occurrence and not the cause of the dislocation. The history in these cases is as a rule confusing and unreliable, and the diagnosis often rests with the radiogram. The small deformed and displaced epiphysis of the head of the femur typical of congenital dislocation is never seen in my experience in the spontaneous displacement. The head may be destroyed in dislocation due to arthritis, and in accordance with Wolff's law it may undergo atrophy in long-standing paralytic dislocation; but it never presents the typical appearance seen in congenital dislocation (cf. *Figs. 29, 31, 36*). The roof of the acetabulum, moreover, is normally developed in spontaneous dislocations.



FIG. 36.—Typical congenital dislocation of right hip. Owing to suppuration in the region of the hip, a diagnosis of spontaneous or 'pathological' dislocation was made.

Finally, difficulty may arise in cases of spontaneous fracture of the neck of the femur. Osteomyelitis of the femoral neck, with spontaneous fracture,

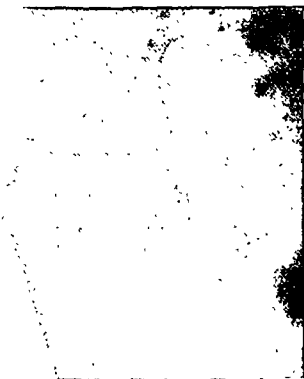


FIG. 37.—Infantile or cervical coxa vara in a boy, age 7.

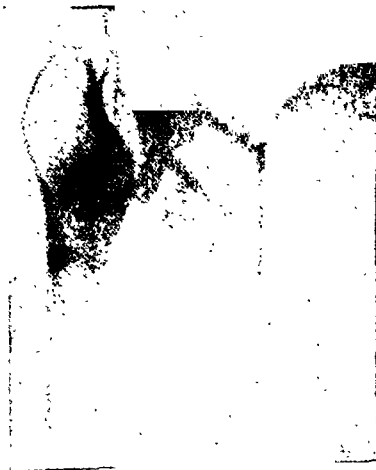


FIG. 38.—Same case as shown in *Fig. 37*, but ten years later. The neck of the femur has been completely absorbed, the head is sequestered in the acetabulum, and the shaft is riding up on the dorsum of the ilium. Clinically, the condition resembled dislocation of the hip.

may in later years present all the clinical signs of dislocation due to infective arthritis. The 'pseudo-dislocation' due to complete atrophy of the neck of the femur in severe cases of infantile coxa vara (*Figs. 37 and 38*) can usually be distinguished from spontaneous dislocation by the history, and of course the radiological diagnosis is final.

spontaneous dislocation by the history,

PREVENTIVE TREATMENT.

A discussion of the treatment of the dislocations under consideration is beset with difficulty. Not only are the underlying pathological changes at variance, but the clinical features of individual cases may differ so completely that each is a problem in itself. Yet, amongst the multitude of possible manifestations, one feature is outstanding in that it is common to all: the limb must have been flexed and adducted before the joint could have been dislocated. It follows that, however variable the corrective treatment may be, the principle of prevention is in all cases identical. It is, moreover, the infinitely more valuable preventive treatment that requires emphasis.

Provided that there is a clear understanding of the mechanism of the displacement, spontaneous dislocation need never occur in an age when the establishment of orthopædic clinics is ensuring earlier and more continuous treatment. I believe that spontaneous dislocation is rarely inevitable, and that in the great majority of cases it is an entirely preventable complication.

Having established the fact that the cause of spontaneous dislocation is a derangement of the normal muscular balance with the production of a flexion-adduction deformity, it is clear that the prevention of dislocation resolves itself into the prevention or early correction of that deformity, with a re-establishment of the muscular balance. In paralytic cases the over-activity of unopposed muscles must be limited by retentive apparatus, preceded, if the conditions demand it, by muscle slide or tenotomy. In spastic paralysis the flexor and adductor muscle groups are over-active as a result of the loss of the cerebral inhibitory control over the spinal centres. The power of such muscles must by operative measures be reduced; and, as far as possible, by physiotherapeutic measures, the power of their antagonists increased.

In cases of acute arthritis it is essential that the reflex muscle spasm of the flexors and adductors be prevented from producing a contracture of the hip. The limb must therefore be immobilized in the fully extended and slightly abducted position throughout the acute phase of the infection, existing deformity being previously corrected by traction in the line of the deformity.

In those cases of acute arthritis in which the head of the femur and the roof of the acetabulum are completely destroyed, simple correction of flexion and adduction spasm will obviously be insufficient to prevent dislocation. Since the bony elements of the joint have disappeared, the femur may ride up on the ilium with the limb in any position, and the essential element of the treatment is continuous and uninterrupted traction. In all other cases, where there is still a roof to the acetabulum, provided the roof is made use of by maintaining extension and abduction of the limb, dislocation in its ordinary form cannot occur.

Unfortunately, however, that Utopian state in which there is no treatment apart from prophylaxis is yet unrealized, and, whatever the future may hold, the demand for corrective measures still exists.

CORRECTIVE TREATMENT AND RESULTS.**GENERAL CONSIDERATIONS.**

If further evidence were required to emphasize the importance of prevention, a consideration of the results of corrective treatment supplies it. The uniformly unsatisfactory results can be readily appreciated when one reflects that the dislocation of the hip is not the only, nor in many cases the worst, element of the disability. Poliomyelitis affects essentially the peripheral muscles, so that cases in which the hip muscles are involved have almost invariably a further involvement of the more peripheral muscles of the limb, and the addition of a flail limb to a dislocation of the hip obviously increases the difficulty of treatment and the gravity of the prognosis. In spastic paralysis there is an even greater obstacle to recovery in the muscular incoordination which exists. Even the dislocations of arthritis of the hip may be complicated by severe bone destruction. In formulating a course of treatment such associated disabilities must receive careful consideration. In all cases they will modify treatment, and in some may indicate the futility of any attempt to improve the patient's condition.

Four general criteria on which operative indications are based and results estimated may be enumerated in the following order: (1) Painlessness; (2) Stability; (3) Mobility; (4) Limp. Painlessness and stability are the primary objects at which to aim, at the expense if necessary of mobility. The fact that mobility of the hip-joint, though useful, is not essential, has been amply demonstrated by the results of arthrodesis for various conditions. A patient with a fixed and stable hip walks with much less limp than one with a mobile but unstable joint. The complete elimination of limping from the gait is the last consideration, and one which in my experience is rarely if ever attained in spontaneous dislocations.

ANTERIOR POLIOMYELITIS.

The ideal treatment of paralytic dislocation is reconstruction of the joint by manipulative reduction of the displacement, followed by immobilization in a stable position.

Manipulative Reduction.—Reduction of paralytic dislocation is seldom difficult, and may succeed several years after the displacement has occurred (*see Case 3*), although, as in congenital dislocations, the prognosis becomes progressively worse as the child grows older. The particular method of reduction which is favoured matters little, provided that the excessively forcible manipulations originally practised are avoided. Preliminary stretching or tenotomy of the shortened adductors may be essential, but complete correction of the flexion-adduction deformity should not be attempted before reduction of the dislocation. Such tight structures may be of considerable assistance in the reduction, and, moreover, it is clearly useless to correct flexion deformity and subsequently to immobilize the hip in the Lorenz position.

The position adopted for immobilization after reduction is important. Frequently the Lorenz position of 90° flexion with 90° abduction is utilized,

and certainly such a degree of abduction ensures stability and precludes all possibility of posterior re-dislocation (*see* p. 39). Flexion of this degree, however, cannot be other than harmful to the already overstretched and paralysed gluteal muscles, and favours a further contracture of the structures below the anterior superior iliac spine. If such a position is used at all, it must not be maintained for more than a few weeks. By gradually bringing the position of the hip down to one of pure abduction, the contracted flexor muscles and anterior capsule of the hip may be sufficiently stretched without demanding open methods. In many cases, however, open division of the contracted structures, or a muscle slide as described by Soutter,²³ is required to correct the flexion deformity.

The duration of plastic fixation necessary to stabilize a congenital dislocation is generally estimated at 8 to 12 months; but fixation for such long periods is only required because the roof of the acetabulum is undeveloped and deficient. In paralytic dislocations where the shape of the bones is normal few cases require fixation for a greater period than 3 to 6 months.

The only complication liable to occur in manipulations of this type is fracture of the neck of the femur. The close association of muscular action with the development of bone is well recognized; and in a limb affected by extensive paralysis, atrophic changes and failure of development occur in the bones to the same degree as in the musculature. Fractures of the femur are therefore more liable to complicate the reduction of a paralytic than that of a congenital dislocation.

In the application of the plaster the increased susceptibility of a paralysed limb to pressure sores must be borne in mind, and the greatest care taken to ensure an adequate and evenly distributed padding beneath the gypsum.

Reefing the Capsule.—The procedure of 'reefing' or 'double-breasting' the posterior part of the capsule of the joint, as an addition to the above treatment, has been recommended by Sir Robert Jones and by Ashhurst.²⁵ Although such a procedure may possibly augment the stability of the joint, it cannot supplant the necessity for the prevention of unbalanced muscular action, for, as has been insisted, contractile muscle is stronger than elastic ligament. All patients must be supplied with instruments; for although the dislocation is reduced, the glutei are still paralysed and there is still a tendency to the production of a flexion-adduction contracture.

Muscle Transplantation.—Theoretically, the correct treatment after reduction is an effort to supplement the power of the weakened glutei by transplanted muscles.²⁶ A. T. Legg has suggested reinforcement of a weakened gluteus medius by the tensor fasciæ femoris, and Lange has endeavoured to replace a paralysed gluteus maximus by the lower fibres of the erector spinæ, and to utilize the vastus externus in cases of paralysis of the gluteus medius. Like most other transplantations in the lower limb, these operations, though feasible in theory, are of little practical value.

Arthrodesis of the Hip.—In young children arthrodesis of the hip is unsatisfactory, because it is almost impossible to secure a firm bony ankylosis. When the cartilaginous head of the femur becomes completely ossified, the operation is feasible, and in certain cases constitutes sound practice. An absolutely stable and painless hip results, and the apparatus required to

enable the patient to walk is much simplified. The contra-indications of the operation are, however, very definite. Unless the muscles of the other hip and of the abdomen are strong, there is inability to swing the pelvis, and walking is impossible. In a case of this type not included in this series an arthrodesis had failed to enable the patient to walk, and the arthrodesed hip had subsequently to be excised in order that the patient might sit in comfort. Moreover, a flail-knee on the same side militates against the success of the procedure. Since in these cases the paralysis is usually widespread, the operation is only occasionally indicated.

Palliative Measures.—In certain old-standing cases none of the above procedures may be possible, and only palliative measures can be adopted. All reconstructive efforts may be abandoned and an attempt made to improve the patient's condition by the simple provision of a surgical boot with walking instruments, by simple tenotomy, or by the performance of an osteotomy to correct the line of weight-bearing; as an alternative the Lorenz bifurcation operation may be performed. Such methods of treatment are discussed more fully in a subsequent paragraph.

RECORDS OF CASES: SERIES I.

Treatment and Results in Lower Neuron Paralytic Dislocations.

Case 3.—F. H., age 8, anterior poliomyelitis, six years' history.

CLINICAL FEATURES.—Right: talipes equinovag. Left: talipes calcaneovalgus, slight genu recurvatum, hip flexed and adducted. Dislocation on left (*see p. 37*).

TREATMENT.—Manipulative reduction. Plaster in Lorenz position (2 months). Re-plaster in abduction (5 months). Walking instruments.

RESULT.—Hip stable, mobile, and painless. No re-dislocation (10 years). Walks fairly well.

Case 4.—I. A., age 8, anterior poliomyelitis, four years' history.

CLINICAL FEATURES.—Right: slight coxa flexa. Left: talipes valgus, genu flexum, hip flexed and adducted. Dislocation on left (*see p. 37*).

TREATMENT.—Open division of hamstrings and of tight structures below anterior superior spine on left. Instruments.

RESULT.—Hip unstable. Becoming worse. To have arthrodesis.

Case 5.—F. M., age 13, anterior poliomyelitis, eleven years' history.

CLINICAL FEATURES.—Left: paresis of most of limb, especially of quadriceps.

Right: talipes varus, thigh muscles weak, hip flexed, adducted, dislocated (*see p. 38*).

TREATMENT.—Walking instruments only.

RESULT.—Hip rather unstable, but can walk with instruments (fair).

Case 6.—H. J., age 23, anterior poliomyelitis over twenty years ago.

CLINICAL FEATURES.—Right: all muscles weak, coxa flexa, no adduction of hip, subluxation only. Paresis right abdominal muscles (*see p. 38*).

TREATMENT.—Nil operative. Massage, exercises, and re-education.

RESULT.—Subluxation not becoming worse. Walk improving.

Case 1.—M. L., age 8, anterior poliomyelitis five years ago.

CLINICAL FEATURES.—Left: genu flexum, hip flexed and adducted. Right: genu flexum, hip flexed, adducted, dislocated. Kyphoscoliosis (*see p. 37, and Fig. 25*).

TREATMENT.—Tenotomy flexors of thigh. Extension. Instruments.

RESULT.—Dislocation unreduced. Condition little improved.

Case 2.—F. R., age 21, anterior poliomyelitis twelve years ago.

CLINICAL FEATURES.—Right: hip abducted, flail below hip. Left: hip flexed, adducted, dislocated, flail below hip, extreme scoliosis (*see* p. 37).

TREATMENT.—No treatment would succeed in making patient walk.

RESULT.—Unrelieved.

SPASTIC PARAPLEGIA.

The treatment of cases of spastic paraplegia of such severity as to be associated with joint dislocation is technically of the greatest interest. Yet after months of treatment, involving countless anæsthetics and an heroic display of orthopædic armoury, the results are disappointing to the last degree. In most cases the disappointment lies not in the failure to effect reduction, but in the fact that muscular inco-ordination is so complete that the patients never learn to walk.

In this type of case reduction of the dislocation must invariably be preceded by an obturator neurectomy and possibly adductor tenotomy. At a later date, operative correction of flexion contracture may be required. Otherwise the treatment of the dislocation itself differs in no respect from that already discussed under the previous heading. The essential element in the treatment of the case as a clinical entity is the post-operative re-education; it is here where the greatest skill, patience, and untiring energy is required, and where failure is most likely to occur.

RECORDS OF CASES: SERIES II.

Treatment and Results in Upper Neuron Paralytic Dislocations.

Case 7.—P. P., age 12. Little's disease.

CLINICAL FEATURES.—Severe spastic diplegia (*see* p. 40, and *Figs.* 27 and 28). Has never stood or walked. Both hips dislocated.

TREATMENT.—Obturator neurectomy, tenotomy of flexors (except psoas), manipulative reduction of dislocation. Plaster immobilization in Lorenz position six months. (Both sides were treated thus on separate occasions.) Neck of left femur fractured during reduction. Also sciatic Stöffel and lengthening of peronei (right and left), tendon transplantations left forearm, manipulation of back, and plaster bed.

RESULT.—Mentality definitely improved. Hips stable and painless, deformities corrected. Patient never learned to stand or walk.

Case 29.—P. T., age 14, Little's disease.

CLINICAL FEATURES.—Severe spastic paraplegia, with congenital dislocation right hip (*see Figs.* 34 and 35). Has never stood or walked.

TREATMENT.—Obturator neurectomy, adductor tenotomy, and Soutter's muscle slide (right and left). Arthrotomy, right hip, attempted open reduction (unsuccessful because of deficient acetabulum). Also sciatic Stöffel, open lengthening tendo Achillis (right and left). Instruments and surgical boot. Re-education in walking.

RESULT.—Mentality undoubtedly improved. Hip unstable, 4 in. shortening (right). Can stand with instruments and a pair of crutches. Cannot walk. (N.B.—This case, though not a true paralytic dislocation, is included here for comparative purposes.)

ACUTE ARTHRITIS.

Seventy years ago, in Charity Ward of Guy's Hospital, John Hilton was practising manipulative reduction of dislocation of the hip in the 'scrofulous

patient', followed by 'mechanical and physiological rest'.²⁰ To this day this is the method of election in early cases of arthritic dislocation.

Manipulative Reduction.²⁸—If the case is seen while the suppurative process is still active, traction should be applied to prevent further displacement, abscesses drained, and general treatment instituted. At a later date formal reduction may be attempted, and at this stage of the disease will usually be successful. If the case is first seen some months or years after the dislocation, manipulative reduction may still be attempted, preceded, if necessary, by traction for some weeks. Successful results are more rare in such cases, because the upper end of the shaft of the femur is usually bound up in inflammatory fibrous tissue; reduction may be quite impossible, and other lines of treatment must be adopted as considered below.

The duration of fixation will usually be greater than that required in paralytic displacements, for in many cases the roof of the acetabulum is destroyed. It is possible that the bone-grafting operation for reconstruction of the upper acetabular lip,²⁹ advocated by Fairbank in some congenital dislocations, may be of value in this type of case. It was not performed in any of the cases reviewed below.

Two serious complications are prone to occur in reductions of this type. In recent acute cases attempted manipulative reduction during the acute phase of the infection may be followed by pyæmia or general miliary tuberculosis, according to the nature of the arthritis. At least one case of this type, with fatal termination, is on record in the literature.³⁰ In later cases there is little danger of lighting up a quiescent infection; but forcible attempts at reduction are very liable to be followed by fracture of the neck of the femur. This complication did not arise in any of the cases in this series, but has been reported by other writers.² Atrophic changes in the bones from both infection and disuse, and considerable resistance from the dense masses of fibrous tissue which surround the head of the femur, combine to facilitate the complication.

Non-reduction of the Dislocation.—It is a recognized fact that many people with congenital dislocations of the hip pass through life without ever seeking advice or treatment, and I recollect a patient of 48 who attended hospital for the first time in her life, with a congenital dislocation. If it is possible to secure moderately good function from an unreduced congenital dislocation, it is still more reasonable to assume that non-reduction of a pathological dislocation may be associated with very little disability. The relative stability of dislocations resulting from acute arthritis has already received comment, and it is true that some patients secure a fairly stable, painless, and reasonably mobile 'joint' without any operative interference. While this is true of a certain proportion, many patients sooner or later either limp badly, complain of pain, or find that walking is difficult. Such disabilities, however, are usually not due to instability—not due to the fact that the femur is not articulating with the acetabulum—but to one or more of the following conditions: (1) Real shortening, or apparent shortening from adduction deformity, causing limp; (2) Incorrect line of weight-bearing causing pain and limp: (a) fixed adduction deformity, (b) displacement of the bearing surface of the femur behind the line of weight-bearing; (3)

Compensatory lordosis or scoliosis causing pain in the back ; (4) Prominence of the great trochanter with local tenderness ; (5) Rarely—instability causing ‘Trendelenburg limp’.

These considerations form the basis on which rational treatment is formulated. Where shortening exists alone, simple correction of this by alterations to the boots may be all that is required. Adduction deformity may be corrected by tenotomy of the adductors and manipulation, or more usually demands a simple osteotomy of the upper end of the femur. Where the incorrect line of weight-bearing is due to backward displacement of the bearing surface of the femur, the Lorenz bifurcation operation is indicated. Lordosis due to backward displacement of the femur, and ‘Trendelenburg limp’ with instability, are also indications for a bifurcation osteotomy. Tenderness over a prominent great trochanter was clearly demonstrated in one case, and was cured by correction of the adduction deformity.

Simple Osteotomy.—For conditions of this nature a wedge osteotomy is sometimes recommended,³² though most cases are satisfactorily corrected by a simple trans- or subtrochanteric linear osteotomy. When there is considerable flexion deformity, a transtrochanteric osteotomy is preferable to a lower one.

Lorenz Bifurcation Osteotomy.—In this procedure an oblique osteotomy correcting deformity is combined with implantation of the lower fragment in the empty acetabulum, in the endeavour to secure a normal line of weight-bearing and to improve stability.³³

Although this was performed in only one of the cases noted below, there is no doubt that it has a very definite place in the treatment of spontaneous as well as of congenital dislocations.

RECORDS OF CASES : SERIES III.

Treatment and Results in Cases of Dislocation from Acute Arthritis.

Case 12.—P. B., age 1 year and 3 months.

CLINICAL FEATURES.—Pneumonia when 7 months old ; few weeks later, hip painful. Pathological dislocation.

TREATMENT.—Abscesses incised and drained. Hip immobilized. Dislocation reduced 1 month later. Plaster in abduction (6 months). Cork in boot.

RESULT.—Hip stable and painless. Movements very limited. Walking well.

Case 9.—D. S., age 1 year and 4 months.

CLINICAL FEATURES.—Septic arthritis right hip when 6 weeks old. Pathological dislocation.

TREATMENT.—Abscesses had been incised and drained and hip immobilized. Dislocation reduced (6 months later). Cork in boot.

RESULT.—Hip stable and seldom painful. Walks fairly well.

Case 8.—G. H., age 2.

CLINICAL FEATURES.—Septic arthritis right hip when 3 months old. Hip dislocated.

TREATMENT.—Manipulative reduction. Plaster in Lorenz position (8 months).

RESULT.—Stable painless hip. Walks well.

Case 20.—C. B., age 5.

CLINICAL FEATURES.—Tuberculous hip, onset eighteen months previously. Hip recently dislocated.

TREATMENT.—Manipulative reduction. Plaster in abduction. Cork in boot.
 RESULT.—Fibrous ankylosis in good position. Walks well, only a slight limp.

Case 13.—V. B., age 6.

CLINICAL FEATURES.—Pneumococcal arthritis four years previously. Hip dislocated. Severe flexion and adduction (*see Fig. 30*).

TREATMENT.—Three attempts at manipulative reduction failed.

RESULT.—Hip quite stable and almost painless. Walks with very bad limp (flexion deformity and shortening). To have a transtrochanteric osteotomy.

Case 14.—H. D., age 6.

CLINICAL FEATURES.—Pyæmic arthritis three years ago. Right hip ankylosed in flexion. Left hip luxated.

TREATMENT.—Transtrochanteric osteotomy on right. No operative treatment on left. Cork in left boot.

RESULT.—Can walk two or three hours without pain. Both hips stable. Left hip movable. No deformity.

Case 17.—A. G., age 10.

CLINICAL FEATURES.—Acute arthritis of hip three years ago. Poliomyelitis during convalescence. Talipes calcaneo-cavo-valgus. Slight genu valgum and flexum. Hip flexed, adducted, dislocated (*see Fig. 29*).

TREATMENT.—Transtrochanteric osteotomy correcting flexion and adduction. Cork in boot. Caliper.

RESULT.—Still wearing caliper. Appears satisfactory.

Case 16.—L. S., age 8.

CLINICAL FEATURES.—Acute arthritis two years ago. Dislocation. Hip tends to adduct on weight bearing.

TREATMENT.—Linear osteotomy through trochanter. Abducted. Surgical boot.

RESULT.—Hip not very stable. Is walking, but limps.

Case 18.—D. S., age 15.

CLINICAL FEATURES.—Arthritis of doubtful origin five years ago. Dislocation. Hip flexed and stiff.

TREATMENT.—Lorenz bifurcation osteotomy. Cork in boot.

RESULT.—Hip stable and practically painless.

Case 19.—T. H., age 25.

CLINICAL FEATURES.—Old pathological dislocation since 5 years of age. False acetabulum. Quite stable but adducted.

TREATMENT.—Tenotomy of adductors and manipulation into abduction. Surgical boot.

RESULT.—Walks with limp. Hip is tending to adduct again, pelvis tilted.

Case 21.—G. M., age 23.

CLINICAL FEATURES.—Tuberculous hip, onset when 7. Dislocated. No flexion, slight adduction deformity. Fair movement.

TREATMENT.—Cork in boot, 4 in., to correct shortening.

RESULT.—Satisfactory. Hip stable. Limps.

Case 10.—P. H., age 7.

CLINICAL FEATURES.—Septic arthritis when 9 weeks old. Dislocation. No deformity. Shortening, $2\frac{1}{2}$ in.

TREATMENT.—Surgical boot. Cork, 2 in. heel, $1\frac{1}{4}$ in. tread.

RESULT.—No pain, but hip unstable and 'Trendelenburg limp'.

Case 15.—W. W., age 11.

CLINICAL FEATURES.—Arthritis five years ago. Dislocation. Shortening, 2 in. Poor acetabulum, head and neck of femur destroyed.

TREATMENT.—Cork in boot, 2 in. heel, 1 in. tread.

RESULT.—Unsatisfactory. Hip mobile and lax, sometimes painful. Walks with limp.

Case 11.—C. D., age 29.

CLINICAL FEATURES.—Acute arthritis in infancy. No deformity. Shortening, 3 in. (*see Fig. 31*). 40° of flexion movement, practically no abduction movement.

TREATMENT.—Has been treated by surgical boot for some years.

RESULT.—Has walked well and without pain until recently. Recently movement of hip is painful, tenderness over great trochanter.

CHRONIC ARTHRITIS.

Little need be said of the treatment of the incomplete displacements of chronic arthritis. Failing more radical measures, further displacement is prevented by the methods outlined earlier. In many cases the treatment is that of the underlying lesion, unmodified by the fact that subluxation has occurred. In osteo-arthritis, for instance, 'excision-arthroplasty' is performed in bilateral cases, arthrodesis in unilateral cases, and possibly in certain patients a pseudarthrosis below the hip.

In the complete dislocations of Charcot's disease (of which there were no cases in this series), a weight-bearing appliance such as Thomas's walking caliper, or other form of stabilizing apparatus, is the best available method of treatment.

RECORDS OF CASES: SERIES IV.

Treatment and Results in Cases of Subluxation from Chronic Arthritis.

Case 22.—Age 8.

CLINICAL FEATURES.—Tuberculous hip, onset six years ago. Subluxation.

TREATMENT.—Recumbency, with traction in extension and abduction. Thomas's knee splint and pattern. Thomas's caliper. Cork in boot, 1½ in.

RESULT.—Hip stable and painless. No tendency to displacement. Mobility—20° of flexion and extension. Walks with limp.

Case 23.—G. S., age 13.

CLINICAL FEATURES.—Old tuberculous hip with subluxation.

TREATMENT.—Correction of shortening by 1 in. cork.

RESULT.—No tendency to further displacement. Walks well.

Case 24.—G. B., age 52.

CLINICAL FEATURES.—Osteo-arthritis—advanced on right, with subluxation.

TREATMENT.—Arthrodesis of hip.

RESULT.—Hip stable, painless, and in good position. Walks very well, very slight limp. Slightly awkward in sitting.

Case 25.—L. W., age 55.

CLINICAL FEATURES.—Bilateral osteo-arthritis, with subluxation on both sides (*see Fig. 32*).

TREATMENT.—To have excision when admitted to hospital.

Case 26.—A. W., age 49.

CLINICAL FEATURES.—Unilateral osteo-arthritis, with subluxation.

TREATMENT.—Pseudarthrosis (Robert Jones's technique).

RESULT.—Hip painless, but flexion deformity is well marked. Walks with stick, limps rather badly. Can sit in comfort.

Case 27.—F. W., age 4.

CLINICAL FEATURES.—Hæmophilic disease of hips (*see pp. 43, 44, and Fig. 33*).

TREATMENT.—Recumbency, traction in extension and abduction. Plaster in abduction.

RESULT.—Can walk now, but both hips are flexed.

One feels that a review of the four preceding series of cases [amply justifies the suggestion already made, that the results of corrective treatment are uniformly unsatisfactory. This applies particularly to the paralytic dislocations, where, apart from the dislocation itself, there is an extensively distributed muscular paralysis. In the arthritic dislocations it is clear that good results can only be expected in early cases where it is still possible to reduce the displacement. In late cases, where only palliative measures can be adopted, though the patients themselves are frequently satisfied, the results are far from ideal. On the other hand, in chronic arthritis, subluxation does not as a rule materially affect the prognosis.

SUMMARY.

1. Spontaneous dislocation of the hip is due to a flexion-adduction deformity of the hip. Flexion alone or adduction alone may cause subluxation, but cannot produce complete dislocation.

2. Paralytic dislocation occurs usually in lower neuron lesions, when the extensors and abductors are paralysed, and the flexors and adductors unopposed.

3. Paralytic dislocation may occur in upper neuron lesions if there is over-activity of the flexors as well as of the adductors.

4. Spontaneous dislocation in infective arthritis of the hip is due to muscle spasm of the flexors and adductors with atrophy of the extensors, and is sometimes aided by bone destruction.

5. Complete dislocation rarely occurs in chronic hip infections, because there is less muscle spasm.

6. Spontaneous dislocation must be distinguished from congenital dislocation with secondary paralysis, myopathy, and infection.

7. The condition can be prevented in both paralysis and infection, by preventing flexion-adduction deformity and by restoring muscular balance.

8. Though most cases can be improved, corrective treatment as a whole is unsatisfactory, because in many cases the dislocation is associated with other irreparable damage.

In conclusion, I would record my gratitude to the Honorary Surgeons of the Royal National Orthopaedic Hospital. Each of them has given me considerable assistance, and allowed me a free hand in the use of his cases. I also wish to express my appreciation of the assistance of Mr. McMurray, of Liverpool, whose cases have also been utilized in the preparation of this paper.

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MULTIPLE POLYPI OF THE COLON.

By SIR W. I. DE C. WHEELER, DUBLIN.

POLYPOSIS of the intestinal tract is not by any means as rare as was formerly supposed. The relative frequency of polypi in the rectum is probably more imaginary than real, for the ease of diagnosis in this situation is in sharp contrast to the difficulties encountered when other portions of the alimentary canal are invaded. Difficulties, both in diagnosis and treatment, were encountered in two recent cases of polyposis of the colon which have stimulated the desire to place them on record and to review some of the literature. In the first case the condition was not recognized either before or during the course of two operations, and yet the findings were so definite that, if a second similar case were encountered, recognition during operation in all probability would present little or no difficulty.

CASE REPORTS.

Case 1.—Polyposis with Symptoms of Ulcerative Colitis.—In May, 1924, a girl, age 26, was admitted to Mercer's Hospital, with a history of constipation, followed after the use of laxatives by loose bloodstained motions which had persisted for two years. Stated briefly the symptoms were those of ulcerative colitis. Palpation revealed tenderness over the right segment of the colon, and an elongated tumour could readily be felt. The temperature ranged from 99° to 102°, running normal for two or three days at a time. Loss of weight, anæmia, pyrexia, and the presence of a tumour led to the clinical diagnosis of a malignant or tuberculous tumour of the cæcum. The possibility of actinomycosis, colospasm, or a specific lesion was considered. No definite information was forthcoming from X-ray examination; the report stated that "twenty-four hours after the barium meal the bowels had moved several times, and very little barium remained in the colon. Some was in the transverse and some was in the pelvic colon, but the relationship of the tumour to the bowel was not defined".

FIRST OPERATION.—After some preliminary treatment with arsenic and by blood transfusions the abdomen was opened.

The colon presented a quite unfamiliar appearance. From just above the cæcum (which was normal) to the junction of the descending with the pelvic colon, the walls were hyperæmic, and infiltrated to such an extent as to convey the impression that any rough handling or angulation would break it in two. There were no adhesions. The ileum and pelvic colon were short-circuited, an appendicostomy was established, and, after removal of a small portion of the bowel wall for examination, the abdomen was closed.

The late Professor O'Sullivan reported that the specimen showed no signs of malignancy, but septic inflammation of the mucous membrane was present.



FIG. 39.—Polyposis of the colon. Drawing made immediately after removal. The cecum and lower portion of the pelvic colon were free from polypi. The specimen weighed $2\frac{1}{2}$ lb.

After three weeks' irrigation through the appendicostomy the patient was discharged from hospital to the country, and told to report again in six months.

On re-admission at the end of this period the tumour on the right side could still be felt. The X-ray report was as follows :—

After six hours the cæcum was incompletely filled and found very irregular in outline. The bowels had moved several times, and only traces of barium were present in the ascending, transverse, and descending colon. A large, oval-shaped, barium-filled sac was shown lying obliquely in the pelvis, and more to the right than the left side.

As this barium-filled sac was not present at the first X-ray examination, it was assumed that the barium collected at the line of the previous ileocolic anastomosis. For five months pain and diarrhoea had continued, but the hæmorrhage which had been present before operation had now ceased.

SECOND OPERATION.—The abdomen was again opened. Neither the appearance nor the feel of the colon had changed; there was the same rigidity of the walls from a level above the cæcum to the pelvic colon; these two portions were normal, and in striking contrast to the remainder of the bowel. A long tube was passed up the rectum and guided through the anastomosis between the ileum and pelvic colon. The colon was removed from the ileocæcal junction to the line of anastomosis. The specimen weighed $2\frac{1}{2}$ lb. (The weight of the average normal colon is approximately 1 lb.) When opened, myriads of polypi were found studded over the mucous membrane without interval from a line just above the cæcum to the lower portion of the pelvic colon (*Fig. 39*).

On the third day after operation the patient became distended, the tube passed through the ileocolic anastomosis did not drain, and ominous black vomiting supervened. Lavage of the stomach and efforts to establish drainage were unsuccessful, and the patient died. An autopsy was refused. The polypi on section were of the adenomatous type.

Case 2.—Infantilism due to Polyposis of the Colon.—The second case was seen in March, 1925. The patient was a girl, 16 years of age, stunted and dwarf-like, but not emaciated. Since early childhood she had suffered from diarrhoea and the passage of blood in the stools. Her height on

FIG. 40.—Infantilism in a girl, age 16, with polyposis of the colon.

admission to hospital was 4 ft. 5 in. and her weight 4 stone 13 lb. (The average normal height at this age is 5 ft. 1 in., weight 7 stone $8\frac{1}{4}$ lb.) The breasts were undeveloped, and there was an absence of axillary and pubic hair (*Fig. 40*). Mentally she was alert and normal.

In the course of routine examination the differential blood-count was noteworthy owing to the great increase of the eosinophils, which raised in the mind of the pathologist a suspicion of the presence of intestinal parasites.

The white blood-cells were as follows: polymorphs 22, lymphocytes 59, large mononuclear cells 5, eosinophils 14; poikilocytosis marked; no nucleated red cells.

Infantilism has been defined as "an anomaly of development characterized by the persistence of the morphological characters of childhood in an individual who has reached or passed the age of puberty" (Zundel). It is not surprising to find infantilism associated with polyposis of the colon, but so far as can be ascertained this is the only case on record.

Apart from the so-called idiopathic infantilism, and the infantilism due to general diseases such as syphilis and tuberculosis, and that form associated with the internal secretion of abnormal glands, chronic diarrhoea from various causes appears to be responsible for the condition in the majority of cases.

Byrom Bramwell¹ calls attention to infantilism of pancreatic origin in which diarrhoea is the prominent symptom, and it is interesting to note that such cases are cured by the administration of pancreatic extract.

Moorhead² reviews the literature and discusses cases of infantilism—pancreatic and intestinal. After a very complete description of a post-mortem on a girl of 18, this latter writer states: "To sum up, the apparently primary pathological change in this case was catarrh of the colon and probably also of the small intestine, and in consequence one may regard the case as one of undoubted intestinal infantilism".

In the case under review the polypi invaded the rectum and could easily be prolapsed, but it was only during the course of two operations that they were found to extend upwards through the descending colon and transverse colon, and probably into the ascending and caecal segment. Proctoscopic examination in this, as in the first case mentioned, was unsatisfactory: it was impossible, after passing through an area of polypoid mucous membrane, to obtain a clear visual field owing to the presence of pus, mucus, and blood.

FIRST OPERATION.—March 3, 1925. The sphincter was dilated. The mucous membrane of the rectum was easily extruded, and was found covered with small polypi. The mucous membrane was raised from the submucous coat by injections of novocain and adrenalin, and a wide cuff was removed.

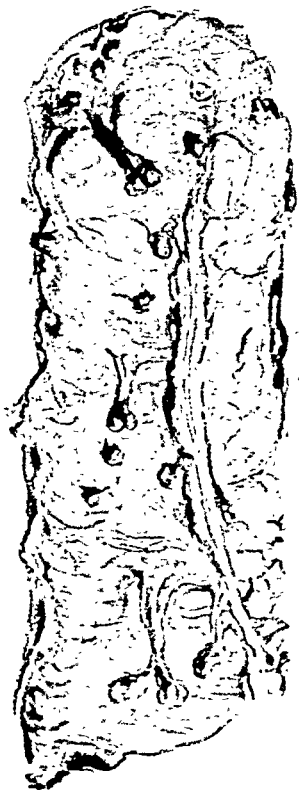


FIG. 41.—Mucous membrane of the excised pelvic colon studded over with polypi.

isolated polypi were cauterized, and the divided mucous membrane was sutured end to end.

The interior of the bowel could be reached to a high level; but at the conclusion of the operation polypi could be felt still higher with the tip of the finger.

SECOND OPERATION.—June 20, 1925. The pelvic colon was exposed through a left paramedian incision. A loop was opened for exploration, and the mucous membrane was found covered with polypi. The loop was mobilized, and the limbs were sutured in parallel fashion and fixed to the abdominal wall by the method of Mikulicz. The extruded portion, measuring $8\frac{1}{2}$ in., was removed after a few days with the cautery. Numerous polypi

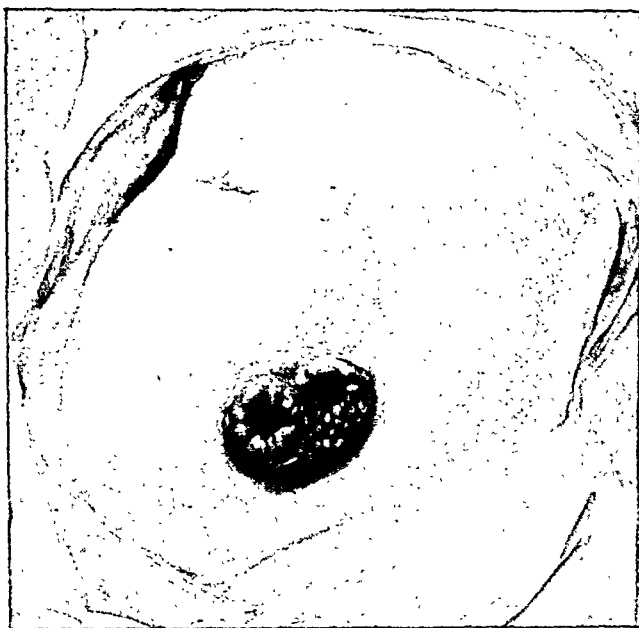


FIG. 42.—Polypi extruded through the colostomy after partial colectomy.

were found on opening the portion removed, but they were not diffuse, and the infiltration and loss of flexibility found in the first case were in consequence absent (*Fig. 41*). A finger passed into the lower limb could detect no trace of further growths; but on examining the upper limb pedunculated polypi could be felt as high as the splenic flexure.

In a few days numerous polypi appeared through the upper limb of the colostomy wound, and were removed with the cautery. A week later, further polypi were extruded and removed in the same way (*Fig. 42*). After an interval of some weeks capillaries containing radium emanation were inserted in the end of a rubber tube and passed through the colostomy to as high a level as possible. The tube was removed little by little so that the emanation would be brought into contact with a wide area of mucous coat. Finally, all

trace of blood disappeared, and the colostomy was closed by crushing the spur and the introduction of a few sutures.

In January, 1926, the mother reported that the child was progressing well; she had put on nearly a stone weight and had grown one inch in ten months. Bleeding and diarrhoea had ceased.

In March, one year after the commencement of treatment, the blood-count approached normal. Eosinophils had fallen to 1 per cent, polymorphs had risen to 75 per cent, large mononuclears 15 per cent, lymphocytes 9 per cent. Pubic and axillary hair had appeared, and there were further signs of general development.

PATHOLOGICAL REPORT.—All polypi appear in section as simple adenopapillomata. No sign of malignancy.

DISCUSSION.

Proctoscopic and X-ray examinations in the two cases under review were of little avail in making a diagnosis. In the first case the rectum and lower portion of the pelvic colon were unaffected, and above this level the field was obscured by fluid faeces, mucus, and blood. X rays confirmed the clinical picture of ulcerative colitis, and later showed the ileocolostomy, but did not go further. In the second case multiple polypi were present in the rectum. Numbers of them attached to a prolapsed mucosa could be protruded through the anus. The field of vision in this case was also obscured when the proctoscope was further introduced along the polypi-bearing mucosa. Barium given through the colostomy opening was not retained sufficiently to give a satisfactory X-ray picture. Reliance is, however, placed on these two methods of examination by Struthers and other authorities. Struthers³ opens a most illuminating paper by alluding to Röntgen-ray examinations and the diagnosis of multiple polypi before operation or death.

All authorities are agreed as to the association between ulcerative colitis and polyposis, and in this connection the possibility of chronic ulcerative colitis in children should be borne in mind. In the second case the symptoms of colitis appear to have commenced at about the age of 10.

Helmholtz,⁴ in recording five cases, the average being under 10 years, says he has failed to find a single article on the subject of this condition of ulcerative colitis in childhood. He thinks it was the terminal stage of ulcerative colitis of adults which was described by Rokitsansky, Virchow, and others as polypi of the colon. According to some authorities the origin is congenital, and others lay stress on the familial type.

Pennant,⁵ commenting on the first case I have mentioned in this paper, describes the post-mortem on a case of polyposis of the colon. The patient's brother was admitted six months later to hospital with a malignant growth in the left iliac fossa. A colostomy was performed, and the colon was found loaded with polypi similar to those found in the colon of his brother. A third brother came to visit him in hospital, and complained of the frequent passage of blood in the stools. The mother died of cancer at an early age, and a sister of carcinoma of the uterus at the age of 24.

There are many references in the literature to intestinal polyposis. Hewitt and Howard,⁶ of Cleveland, refer to cases published as far back

as 1721, 1832, 1839, and 1861, and two more recent cases recorded in 1905 and 1913. The formation of polypi following chronic ulcerative colitis is emphasized. The following cases are mentioned as illustrative of many interesting points :—

A woman, age 36, under the personal observation of Hewitt and Howard, in about the year 1905, had been afflicted for a considerable time with severe diarrhœa, and died in hospital a few weeks after admission. At the post-mortem examination the only lesion of importance found was in the colon. Here the entire mucous membrane, from the ileocæcal valve to the rectum, was uniformly deeply ulcerated, with ragged tags of mucosa scattered widely.

A second case, a man, age 40, was admitted to the Cleveland City Hospital in 1913. Diarrhœa was again the outstanding feature ; the temperature was variable, but never above 101°. The patient died in hospital. At post-mortem examination, the mucosa of the lower two-thirds of the ileum was injected, œdematous, and its surface covered with a thin, greyish layer of exudate. In the lower portion of the ileum, near the ileocæcal valve, and in the cæcum, there were single ulcers, which are minutely described. On the base of several of the largest ulcers there were attached islands and tags of mucosa and submucosa. The wall of the mucosa was thickened, rather fibrous, and stiffly flexible. In the ascending and transverse colons there were many small tufts of mucosa attached by slender pedicles easily detached by passing the finger over the surface. Just above the sigmoid flexure there were a few small polypoid projections ; they were stubby and attached by a relatively thick pedicle ; and, above this again, there was a cluster of large and long polypoid masses. The sigmoid flexure itself was the site of many projections, becoming more numerous as they extended downwards to the external sphincter, but in all there were not more than forty such projections.

Hewitt and Howard thought, from a study of these two cases, that the islands and tags of mucosa and submucosa had been the source of the polypi, which appeared to depend for their preservation on the blood-vascular arrangement, for it was noted that the polyps in the rectum were situated along the side of the intestinal wall, while higher up and in the colon the polyps were situated along the line of attachment of the mesentery, an arrangement that coincides with the blood-supply of the parts.

It is assumed that the beginning of the disease is a general ulcerative colitis. The ulcerative process is of such a character that portions of the mucosa and submucosa adjacent to the primary arterial branches are preserved, and these portions remain as ragged tags scattered over the surface of the colon. As the ulcers heal, these tags become smoothed off, and remain as rounded sessile elevations, or as polypoid projections of the mucous surface. Later on, as cicatrization proceeds, the orifices of certain of the tubules situated in and between the polyps may become occluded, and retention cysts form, giving rise to what Virchow called 'colitis polyposa cystica'. It is the end-stage of colitis polyposa. By some authorities a subtle distinction is made between adenomata, papillomata, and true polypi ; but it appears likely that one is but a stage in the development of the other.

In the *Proceedings of the Royal Society of Medicine*, 1914, cases are recorded by Ivor Back, Gordon Watson, Norbury, and Furnivall.

Back's patient was a girl, age 24. The condition was diagnosed, microscopically and clinically, as carcinoma of the rectum. A colotomy was performed, and adenomata were found extending up into the transverse colon, and they subsequently bulged through a colotomy opening. About a

year later she put on weight rapidly, and the polypoid excrescences had disappeared from the rectum and from the region of the colotomy wound.

In Gordon Watson's case there were numerous œdematous polypi throughout the large intestine, with carcinomatous change in the sigmoid flexure. After resection of the sigmoid the patient ultimately died of hæmorrhage, and secondary growths were found in the lumbar glands and the liver.

Norbury's case was one of multiple polypi of the rectum and colon, with prolapse of the bowel. The rectum and pelvic colon were studded with small sessile polypi which were afterwards found to extend as high as the descending colon. Fixation of the bowel to correct the prolapse, with appendicectomy, was the operation performed.

In a discussion which followed, Lockhart-Mummery said that he believed that the only satisfactory treatment for these cases was complete excision of the entire colon after an ileorectostomy.

The late J. B. Murphy⁷ recorded a case of polyposis of the sigmoid, and says that the etiology of intestinal polypi, like that of the common wart, is shrouded in mystery. Whence they come, how they go, is like the riddle of the Sphinx. Quoting Carroll, of the Mayo Clinic, he says that intestinal polyposis is a comparatively rare disease. Polypoid growths may occur at any point along the gastro-intestinal tract; but in the majority of cases they are found in the large intestine, usually at its turning points, and in the rectum. A diagnosis can be made only when the polypi are seen or felt. In Murphy's case the microscope showed adenoma with suspicious areas of active cellular proliferations.

Lockhart-Mummery⁸ describes a case of complete resection of the large bowel for multiple adenomata. Numerous adenomata were found in the rectum and sigmoid which extended as high up as the cæcum and all through the transverse colon. The specimen showed multiple adenomata of a simple character throughout the entire large intestine.

Struthers⁹ illustrates two specimens which appear almost identical with the specimen illustrated in *Fig. 39*, but in both his cases an adenocarcinoma was found in the rectum. He gives an excellent review¹⁰ on what he calls "multiple polyposis of the gastro-intestinal tract". Eighty-four cases in all are considered, two of which showed multiple polypi in the small intestine, an extremely rare condition. The various portions of the gastro-intestinal tract involved, according to this writer, are as follows: stomach, 4 cases; cæcum to the rectum, 3; rectum and sigmoid, 2; hepatic flexure and small intestines, 1; small intestines, 1; transverse colon, splenic flexure, and descending colon, 1; descending colon and sigmoid, 1.

Cope¹¹ publishes one case of multiple papillomata of the small intestine causing recurrent intussusception in an adult; and Mills¹² reports a case of multiple polypi of the stomach, a condition which is generally regarded as of great rarity.

The question of ultimate malignancy is discussed, and Lockhart-Mummery is quoted as having said that almost all recorded cases of multiple polypi of the colon eventually became malignant, and that this was the factor to be reckoned with in treating these cases.

Erdmann and Morris¹³ state that the disease has a marked predilection

for the male sex, but this statement is not borne out by a reference to the published cases. Attention is called by these writers to the fact that the adenomatous type of polypi is most frequent in the large intestine, usually in a multiple and widely disseminated form. The malignancy incidence they state is 43 per cent (Soper).

Soper¹⁴ calls attention to the fact that "comparatively few cases of multiple polyposis of the colon are reported in literature". He analyses the grand total of 61 cases, and calls attention to the tendency for the growths to occur in the same family. A case is described (the second on record) in which the entire colon was successfully resected for polyposis.

In view of the distribution of the polypi in *Case 1*, it is interesting to note that, according to Soper, the rectum and sigmoid are involved in 95 per cent of all cases of polyposis of the colon. He thinks that sigmoidoscopic examination is the only means by which an accurate diagnosis can be made.

T. S. Swan¹⁵ resected a portion of the transverse colon by the Mikulicz method for the removal of a papillary adenoma. The diagnosis was made by exploration. Diarrhoea with the passage of blood was the outstanding symptom.

CONCLUSIONS.

1. There is a close association between ulcerative colitis and polyposis. Ulcerative colitis occurs in children as well as in adults.

2. The majority of cases sooner or later become malignant.

3. A condition of infantilism may result from polyposis of the colon in early life.

4. Polyposis of the colon cannot be diagnosed unless the polypi are seen or felt. Satisfactory X-ray and proctoscopic examinations are only possible in a proportion of cases.

5. When multiple polypi of a very diffuse nature are present in the colon there is a characteristic infiltration and want of flexibility in the walls which is unlike any other pathological condition. When handling the colon the increase in weight is very striking.

6. The prognosis is bad unless colectomy is performed. Ileostomy, cæcostomy, or appendicostomy, followed by irrigation, has been successful in a few cases.

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DUODENAL ILEUS.

By JOSEPH E. ADAMS, LONDON.

My attention was first directed to this condition by the American literature on the subject. It has been claimed that the chronic form can be recognized on clinical grounds by observation of a dilated duodenum seen through the abdominal wall and by local tenderness just to the right of the umbilicus. In this country D. P. D. Wilkie gave an admirable account of the condition at the Meeting of the Association of Surgeons in Edinburgh in 1921, and his paper was published in the *BRITISH JOURNAL OF SURGERY*.¹ During the past five years I have been on the look-out for such cases, and wish to place on record the five which I have had under my care.

The American view seems to be that it is a condition with a well-defined individuality, whereas Wilkie regards it as one of the manifestations of general visceroptosis. For my own part I do not claim to be able to diagnose it without the assistance of radiography, but I do not feel convinced that visceroptosis is necessarily present. Its relationship to acute gastromesenteric ileus, or acute dilatation of the stomach, which is an occasional unfortunate sequel of almost every type of operation, is a question to which Wilkie pays great attention, and herein lies the particular value of his paper. He asks three very pertinent questions—namely: “(1) Does a chronic obstruction of the duodenum from mesenteric compression never occur? (2) If it does occur, does it give rise to no recognizable clinical picture? (3) May it not be the precursor of the acute post-operative condition?”

I think the answer to the first question is that operation may reveal a dilatation of the duodenum which definitely ceases at the point where the mesenteric vessels cross over it. The second suggestion seems to be true if we include radiographic evidence in the clinical picture. As to the third point, Wilkie himself brings forward very positive evidence, and it would appear to offer an attractive explanation of the fact that what used to be called acute dilatation of the stomach also includes dilatation, sometimes very considerable, of the first three parts of the duodenum, and never of the fourth part beyond the mesenteric vessels.

The obvious difficulty in accepting chronic duodenal ileus as a clinical entity is the fact that compression of the duodenum by the mesenteric vessels is likely to be a congenital defect, whereas the symptoms are rarely manifest before the age of twenty. The cumulative effects of visceroptosis may be claimed as the determining factor in the causation of the symptoms. If this is so, a complete X-ray examination of the intestinal tract should demonstrate the presence of visceroptosis in all, or nearly all, cases of duodenal ileus. This has not been my own experience, and three out of the four more or less chronic cases herewith considered did not exhibit general visceroptosis. Gastropptosis, on the other hand, was present in three out of the four cases,

and the stomach was flaccid and low in position. In two of them, operated upon on the same day, the state of affairs was so similar that when the second abdomen was opened it looked as if we must be dealing with the same patient all the time. The most striking anatomical feature of these two cases was the fact that the pyloric vein, which encircles the bowel and affords a definite landmark between stomach and duodenum, was seen to be *horizontal*. This was observed as soon as the peritoneal cavity was opened and before anything had been touched, and I think it may afford a further suggestion as to the etiology of the condition. Normally, the pyloric vein is placed vertically, and the first part of the duodenum is horizontal, or nearly so. If

the stomach, especially its greater curvature, be dragged downwards, it is easy to see that the pyloric vein may be rotated so that it becomes horizontal. The first part of the duodenum will tend to become vertical. If this drag, originating in the stomach and due to its ptosis and dilatation, be communicated to the duodenum owing to incomplete fixation of its first part, it will pull the duodenum like a cord on a pulley around the head of the pancreas, and the next drag will be exerted where the duodenum is most fixed, namely, at the duodeno-jejunal flexure. The duodenum on the proximal side of this lies behind the root of the mesentery with its contained vessels; thus it may be impossible to differentiate between a dilatation

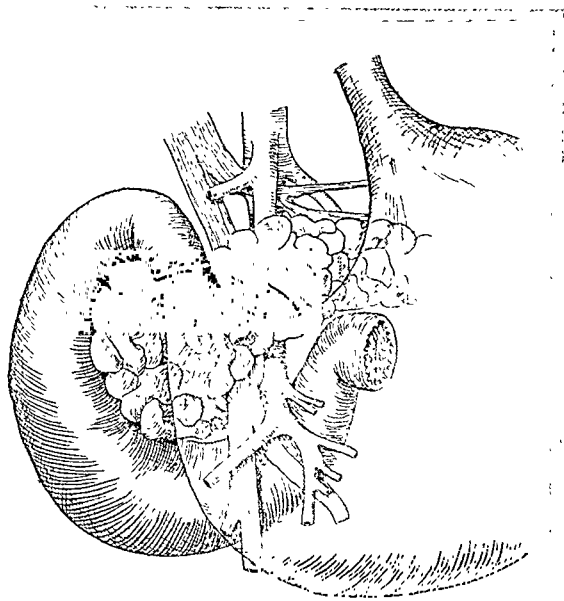


FIG. 43.—To illustrate ptosis of the stomach communicated to the duodenum. First part of duodenum pulled down to a vertical position; pyloric vein horizontal; duodenum pulled round head of pancreas as a pulley; head of pancreas displaced forwards: dilatation of first three parts of duodenum; no constriction by superior mesenteric vessels.

which starts in the stomach and one which is due to the pressure exerted on the last portion of the duodenum. In several of my cases a very striking feature was the displacement of the head of the pancreas as if it had been pulled forward out of its bed, and this, I suggest, would result from such a duodenal pull as I have outlined. (*Fig. 43*; cf. *Fig. 44*.)

What is really wanted, if mesenteric vessel pressure is to be accepted as the causative condition, is dilatation of the duodenum without dilatation of the stomach. This was present in the third case of my series. That acute dilatation of the stomach was recognized long before the term acute gastromesenteric ileus was substituted for it lends colour to the view that the

dilatation of the stomach is commonly the primary lesion. The result of the pull of a dilated stomach, in the absence of pyloric obstruction, must depend on the fixity or otherwise of the first part of the duodenum. If this is anchored in the usual fashion, the dilatation cannot readily be communicated to the intestine; but my experience of these cases shows that the first part of the duodenum is loosely supported, and therefore the direction of the pyloric vein is easily altered. It is dragged down to occupy a horizontal position, the first part of the duodenum becomes vertical, and the rest of the duodenum, with the exception of its fourth part, becomes progressively involved in the distention. In cases of acute dilatation it has been observed that only the first part of the duodenum may be involved, and this may be explained by the fact that death had supervened before full dilatation occurred.

In other cases, where the examination has been made on the post-mortem table, the dilatation involves the duodenum as far as the point of crossing of the superior mesenteric vessels. Surely this is the last phase, when death has occurred late. If it be true that duodenal obstruction is particularly dangerous because of the special toxicity of the duodenal contents, one would expect fatal cases to be discoverable where the vessels had obstructed the duodenum, with, as yet, an undistended stomach. As far as I am aware, such cases are not met with.

Acute Gastromesenteric

Ileus.—The ordinary type of acute gastromesenteric ileus was well exemplified by a fatal case in my own ward nearly two years ago, the details of which are as follows:—

Female, S. B., age 37. Admitted in May, 1923, with a history of dyspepsia for several months and three weeks' persistent vomiting. Fullness of abdomen has increased day by day. Can only take fluids. Very emaciated. Stomach obviously occupying the whole of the abdomen. In a very feeble state.

Treated by lavage and posture and injections of pituitary. Stomach reduced to level of umbilicus, with visible peristalsis. Died rather suddenly thirty-six hours after admission.

POST-MORTEM.—Emaciated body. Heart and lungs normal. Stomach enormous,

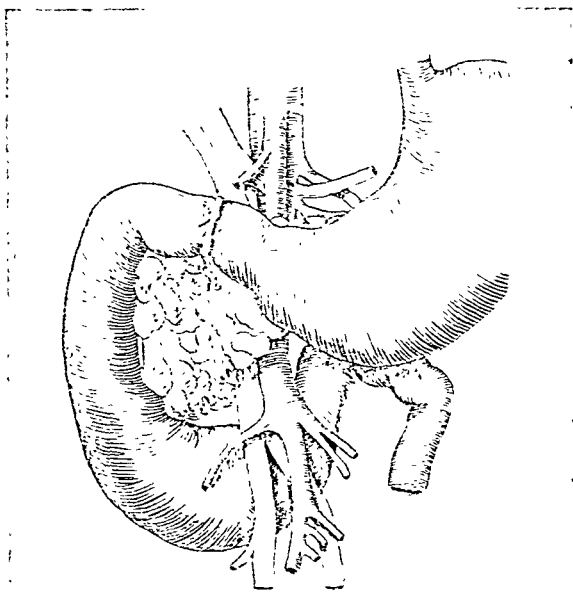


FIG. 44.—To illustrate ileus of the third part of the duodenum from pressure of the superior mesenteric vessels. Stomach, first part of duodenum and portion of second part and fourth part of duodenum, and jejunum entirely unaffected; pancreas not pulled forwards; pyloric vein vertical; first part of duodenum horizontal.

reaching to level of the pubes. Duodenum also dilated to the point where mesenteric vessels cross it. *Head of pancreas pressed forward.* No obstruction in duodenum, and no ulcer of stomach or duodenum. Mesentery of small intestine abnormally long and thin. No definite visceroptosis.

Unfortunately, no special observation was made at the necropsy as to the direction of the pyloric vein, but the displacement forward of the head of the pancreas did call for very special comment. The absence of any marked visceroptosis is also important.

The other cases I have encountered belong to the chronic class, although the length of history was a very variable one, and it is most difficult to estimate when the duodenal ileus actually began to occur, for if ptosis and dilatation of the stomach are the primary condition, it is reasonable to expect a rather vague and uncertain onset of the symptoms. In one case indigestion had been present for at least thirty years, in another only three months, yet the appearance of the duodenum in the two cases was precisely similar.

CHRONIC DUODENAL ILEUS.

Case 1.—A. B., male, age 40, pencil maker. Admitted April 30, 1924; discharged May 10, 1924.

HISTORY.—At least ten years' history of pain one to one and a half hours after food. Relieved by vomiting, made worse by food. Very little pain when on light diet. Had a course of treatment in medical ward in 1921. Pain has gradually returned. It was troublesome at Christmas, 1923, and has been getting worse since. Patient brings up a good deal of fluid, which is not acid in character, and is troubled with flatulence. Appetite poor. No hæmatemesis. No history of venereal disease. Underwent a successful operation for piles in March, 1922.

ON ADMISSION.—A fairly well nourished man, with teeth in good condition. Tongue a little furred. Fauces clean. Abdomen not rigid at any point, and only markedly tender when the pain is present. There is, however, slight tenderness on deep pressure just to the right of the umbilicus. No 'pressure paradox' found. A dilating powder was given and showed clearly the outline of the stomach, its upper border being about the level of the umbilicus and the greater curve low down in the hypogastrium. Ewald test meal: Free HCl, 0.058 per cent; combined, 0.040 per cent; total, 0.098 per cent.

X-ray Report.—Low hypotonic stomach. Peristalsis not very active. Pyloric antrum irregularly filled. Duodenum dilated and persistently filled in all parts. After four hours, persistent shadow still present in the duodenum. Considerable gastric residue. No evidence of ulcer. Condition suggests duodenal ileus.

OPERATION.—May 15, 1924. Right paramedian incision. Pyloric vein horizontal. First part of duodenum vertical and dilated. Some adhesions between gall-bladder and duodenum at the junction of its first and second parts. Second and third parts of the duodenum very dilated, three-quarters of the lumen of the duodenum in its third part being below the level of the attachment of the transverse mesocolon. Jejunum small, with apparent compression at the duodenojejunal flexure by the superior mesenteric vessels. The mesentery appeared to drag at this point, but there was no general visceroptosis. The stomach was flaccid, and low in position. The head of the pancreas projected forwards within the circle of the dilated duodenum. The adhesions mentioned above constituted an obstruction at the junction of the first and second parts of the duodenum, and therefore it was decided to treat the case by doing a posterior gastro-enterostomy.

POST-OPERATIVE HISTORY.—With the exception of slight pulmonary infarction the result was very satisfactory, and the present condition of the patient is good. A skiagram taken in February, 1925, showed no residue in the duodenum.

Case 2.—L. F., male, age 23, clerk. Patient was of marked neuropathic tendency, a confessed chronic masturbator, anæmic, and depressed.

HISTORY.—Pain in the epigastrium for three months, usually half an hour after food. Sensation of heaviness below the left costal margin, relieved to some extent by light diet and rest in the recumbent position. Intensity of pain proportional to amount and solidity of food. Vomited only once, three weeks before admission, one hour after breakfast. Pain not relieved by this. Suffers from chronic constipation.

ON EXAMINATION.—Tongue coated, breath fœtid. Abdomen tender in epigastrium below left costal margin and $\frac{1}{2}$ in. to the left of the middle line. Slight rigidity of upper part of left rectus muscle. No cutaneous hyperæsthesia. Slow pulse of low tension. Urine: 1010, acid; no albumin or sugar. Ewald test meal: Free HCl, 0.135 per cent: combined, 0.036 per cent; total, 0.171 per cent.

X-ray Examination.—Large hypotonic stomach, emptying rather slowly. Duodenal cap normal. Transverse segmented shadow shows some retention in third part of duodenum, interpreted to mean duodenal ileus.

OPERATION.—May 15, 1924. Right paramedian incision. Pyloric vein horizontal. First part of duodenum vertical and adherent to neck of gall-bladder. Duodenum dilated, especially in its third part, which lay entirely below the level of the transverse mesocolon. No ulcer in the duodenum or stomach. The latter was flaccid and low in position. The first part of the jejunum was normal, and the appearance suggested compression of the superior mesenteric vessels. There was evidence of a drag on the mesentery of the small intestine. The appendix was slightly adherent and was removed. The cæcum and ascending colon were mobile. There was no Lane's band, but a well-defined Jackson's membrane was present. The hepatic flexure was low in position, and a cholecystoduodenal fold was seen.

Treatment consisted in a vertical duodenojejunostomy, and the digestive symptoms were promptly relieved.

POST-OPERATIVE HISTORY.—About a week after the operation the patient developed mental symptoms, and began to decline food, because he always wanted something different from the hospital diet provided. Fortunately this phase did not last long, and when last seen, early this year, he was in excellent physical condition, with good appetite, free from pain, and taking a renewed interest in his work.

Case 3.—E. L., male, age 50, lamp attendant. Admitted June 9, 1922; discharged Sept. 9, 1922.

HISTORY.—Had pleurisy in London Fever Hospital twelve years ago; ill for three months.

For thirty years had had indigestion of intermittent character; worse during the last few years, especially in cold weather. Pain comes on one to one and a half hours after food; is felt at umbilicus and towards right iliac fossa, and then round the left loin, as if a cord were tied round patient at level of left costal margin. These pains come on three or four times a week, and are relieved by vomiting. The vomit contains bile and is greenish in colour. No hæmatemesis. Chronic constipation for thirty years. No melæna. Careful in diet since Christmas, 1921. Some loss of weight. Symptoms during this time have grown worse.

ON EXAMINATION.—Thin, wasted man. All teeth have been extracted except one upper left molar stump. Tongue clean. Pharynx normal. Abdomen rather distended all over; some visible veins on abdominal wall; tender around navel, and more definitely so when firm pressure is applied 2 in. inwards from the left anterior superior spine. No mass palpable anywhere. Urine, nil. Chest, nil. Central nervous system normal. Ewald test meal: Free HCl, 0.091 per cent; combined, 0.040 per cent; total, 0.131 per cent.

X-ray Examination.—Fair residue in stomach after six and a half hours. Second meal shows stomach low in position, with good tone. Feeble peristalsis, and deformity at pyloric end. Partial obstruction at or near the duodenum.

On June 21 there was no pain in abdomen, but a good deal of flatulence and eructation. There was some pain on micturition, attributed by patient to the flatulence. Muscular cramps in legs below knees.

OPERATION.—June 28, 1922. Right paramedian incision. Stomach normal, and pylorus normally placed. First and second parts of duodenum only slightly dilated. Marked dilatation of third part of duodenum seen below transverse mesocolon. Commencement of jejunum narrow. Difference due to pressure of superior mesenteric vessels and extra folds of peritoneum, with obvious drag on root of mesentery. Appendix distorted and adherent in proximal third. Catarrhal changes. Treated by vertical duodenojejunostomy with catgut.

POST-OPERATIVE HISTORY.—Rather severe pain for two days after operation, but then well until July 17, when he began to have thrombosis in the left femoral vein. (This leg was infused with gum during operation.) *No digestive trouble.*

July 14.—Barium meal. Patient examined in bed (semi-prone). Stomach lying well to the left. Duodenal cap not filled; after one and three-quarter hours very little had left stomach; after four hours stomach quite empty. No residue in any part of duodenum.

July 25.—Got up, but fainted and had to be put back to bed. *Enjoys food.*

July 31.—Pain of stabbing nature felt in right shoulder on inspiration present the last two nights.

Aug. 3.—Distinct pleurisy in right side, followed a fortnight later by similar trouble at left base; no effusion occurred on either side, but some crepitations were heard. Did not spit up any blood.

Discharged in good condition. No abdominal symptoms when seen subsequently on Sept. 11, 1922.

Reply to letter of inquiry March 17, 1925: "At work and greatly improved though not robust. Has to be careful as to diet."

Case 4.—P. C., male, age 42, labourer.

HISTORY.—Indigestion and pain in the epigastrium for seven years. Marked loss of appetite and occasional regurgitation of food. Twelve months before admission had a severe attack of epigastric pain, with vomiting, which lasted for eight hours. Never quite free from pain since; always epigastric in position, usually severe in character, with brief intermissions. Attacks of greater pain used to occur weekly; now they come on daily and even four times in the twenty-four hours. Nearly always followed by diarrhoea. Patient is sometimes doubled up with pain, and then fluid passes up into the mouth, and stomach feels as if dragged upon. Pain rather more in the right than the left half of the epigastrium. Worse as the day passes, and aggravated by food. The pain does not keep patient awake at night. There has never been hæmatemesis or melæna. No history of jaundice. Pain at its maximum one hour after food.

ON ADMISSION.—Slight tenderness in right half of epigastrium with some hyperæsthesia. No paradoxical sign. Ewald test meal: Free HCl, 0.0766 per cent; combined, 0.0511 per cent; total, 0.1277. Barium meal: Six and a half hours after first meal residue in stomach and first part of duodenum, the latter lying alongside the hepatic flexure and inseparable from it. Second meal shows gastroptosis with pyloric end of stomach drawn over to the right. Duodenal cap dilated but with a clear outline. Emptying very slow; cannot be assisted by manipulation.

OPERATION.—July 3, 1925.—Right upper paramedian incision. Stomach greatly dilated and low in position. *Pyloric vein vertical.* First part of duodenum $3\frac{1}{2}$ in. in diameter and firmly adherent to gall-bladder at junction of first and second parts. No ulcer of stomach or duodenum. Second part of duodenum $2\frac{1}{2}$ in. across. The adherent gall-bladder probably prevented rotation of the pyloric vein, and the first part of duodenum remained horizontal instead of becoming vertical. Third part of duodenum distended to width of three fingers below the attached transverse mesocolon. Jejunum normal in size. No clear evidence of dropped mesentery obstructing the fourth part of the duodenum. Head of pancreas not displaced forwards. Treated by vertical duodenojejunostomy.

POST-OPERATIVE HISTORY.—Patient did very well after operation until September, when he had to be operated upon in a hurry for acute small-bowel obstruction due to a band resulting from the first operation. He has made a good recovery from this.

A consideration of the clinical aspect of these cases does not lead to the conclusion that the diagnosis can be made with any degree of certainty without the aid of radiography. Kellogg,² on the other hand, claims to be able to diagnose the condition by a scrutiny of the history and physical examination of the patient. If only the first part of the duodenum is involved, the case resembles pyloric obstruction, but in the true complete cases symptoms are partly toxic and partly mechanical: headache, depression, cold extremities, with pain or dull ache just above and to the left of the umbilicus—presumably at the duodenojejunal junction—or pain to the right of the middle line beneath the liver, passing through to the back. The pain is often relieved by pressure, but in some cases only by vomiting. The vomit in these cases usually contains bile. Hayes³ speaks of two physical signs as characteristic: (1) Tympanites beneath the upper right rectus in the region of the pylorus associated with gastric retention; and (2) The 'pressure paradox'. This is exemplified by the effect of upward and backward pressure by the hand just below the umbilicus for half a minute. This will enable gas to escape past the duodenojejunal kink, relieve the distention, and therefore lessen the tympanites in the pyloric area. Gas may be heard or felt to gurgle through the constriction beneath the hand, and pain disappears. Kellogg has verified these signs, but he admits that there may be fallacies, since the duodenum may not be distended at the time of the examination, whereas the colon or stomach may be distended. Furthermore, who shall say that the distention is that of the duodenum itself? Such an accurate observation appears to me to demand too high a capacity for any ordinary clinician. The pressure paradox sounds convincing, but I have failed to demonstrate it in my cases even after the diagnosis was made by the radiologist. It would seem more reasonable to state, as Moynihan has with regard to gastric ulcer, that the only two persons who can make the diagnosis with certainty are the radiologist and the surgeon, and the latter can only do so after the abdomen is opened. The condition may be apparent at once, and I have already pointed out the importance of the forward displacement of the head of the pancreas and the horizontal position likely to be taken up by the pyloric vein.

Kellogg is of the opinion that only a small proportion of the cases require surgical treatment, but that relief can be obtained by a suitable support for the enteroptosis, which he regards as primary. He also urges the desirability of combining fixation of the hepatic flexure of the colon and cæcum with duodenojejunosomy in those cases where the severity of the symptoms demands operation. Bloodgood⁴ has also described cases treated on these lines.

In my own practice I have recently explored the abdomen of a woman whose enteroptosis was associated with ileus certainly affecting the first two portions of the duodenum.

Case 5.—A woman, age 30, unmarried. Since January, 1922, she has had persistent abdominal pain, with loss of appetite but a feeling of want of food. Pain is felt mainly in the epigastrium and right loin, and is not materially altered by the taking of food or dieting. Attacks of nausea, headache, and giddiness are common, but little actual vomiting occurs. In January, 1923, her appendix was removed and some adhesions were divided in the right iliac fossa. This operation gave her

no relief, and I first saw her in July, 1923. At this time she presented rather a miserable appearance, thin, with a raw tongue and low-tension pulse. There was some tenderness in the upper right portion of the abdomen. The cæcum was distended; both right and left kidneys were definitely mobile, but she presented no other physical signs on examination. The bowels were constipated unless she took liquid paraffin. An Ewald test meal revealed: Free HCl, 0.219 per cent; combined, 0.072 per cent; total, 0.291 per cent. X-ray examination gave positive evidence of generalized visceroptosis. I considered that she was not a suitable subject for surgery, and prescribed an abdominal belt to support the prolapsed large intestine. In May, 1924, her general practitioner, Dr. J. A. Clark, of Sittingbourne, reported that she was no better, and about this time she had further trouble owing to the sudden death of her father and the severe illness of a brother. At her earnest request the question of operation was reconsidered this year, and after a further radiographic examination it was decided to explore the abdomen. The determining reason was that the skiagram strongly suggested the presence of a lesser curve ulcer. Two examinations were made, and there was a well-marked persistent spasm on the greater curvature of the stomach, which was J-shaped and hypotonic, with a suggestive shadow of a 'hold up' at a point on the lesser curve. No ulcer, however, could be found at the operation.

The state of affairs presents to my mind an early stage of duodenal ileus, with very little evidence that compression of the last part of the duodenum by the superior mesenteric vessels is an essential causative factor. In the first place the great omentum was adherent to the anterior abdominal wall low enough down to drag on the transverse colon. The stomach was large and flaccid, low in position, and J-shaped, with a vertical pyloric canal and *horizontal pyloric vein*. Its walls were quite healthy and free from adhesions. The first part of the duodenum was almost vertically placed, and at least twice as big as usual. There was no kink at the junction of the first and second parts, and the latter portion was equal to the first part in diameter. As the third part was reached, there was a lessening in size of the duodenum; but on pulling up the transverse colon it was observed that the duodenum could clearly be seen below the level of the transverse mesocolon; its lower border lay about a finger-breadth below the line of attachment of the mesentery. The head of the pancreas was not unduly prominent, but it was easily felt. There was certainly no evidence of collapse of the first part of the jejunum; in fact the bowel at this point was rather large and thick-walled. There was no sign, therefore, of compression by the superior mesenteric vessels, and no drag upon them by the mesentery of the small intestine could be demonstrated. It would, however, have been quite easy to expose the third part of the duodenum and anastomose it to the jejunum. The gall-bladder and bile-passages were normal and no bands passed from the gall-bladder to duodenum or colon. The hepatic flexure of the colon was ill-defined and not secured to the posterior abdominal wall. A very definite Jackson's membrane was present, whilst the cæcum was large, flaccid, and mobile. No Lane's band was found, but there was a well-marked fold producing a kink in the ascending colon just above the Jackson's membrane. Undoubtedly the mobile cæcum and ascending colon could have exerted a pull on the mesentery; but if that was the cause of the dilatation of the duodenum, why should it affect the third portion less than the first and second? In my opinion the drag was exerted on the other end of the duodenum, and I hold that gastropptosis was responsible for the duodenal ileus, the horizontal line of the pyloric vein pointing strongly in this direction. The gastropptosis no doubt was partly due to the downward drag of the transverse colon, which was ill-supported, as well as the loss of tone in the stomach itself.

Treatment was directed to the relief of the mobility of the cæcum and the downward displacement of the hepatic flexure of the colon, together with plastic division of the cæcocolic fold. The Jackson's membrane was not disturbed; but the hepatic flexure and cæcum were sutured with silk to raw areas made in the posterior parietal peritoneum. Had the third part of the duodenum been more dilated, I should also have done a duodenojejunostomy. It will be necessary to

insist on the patient's wearing an abdominal support, and time alone can show whether the right treatment has been adopted. If the result is not satisfactory, I think there will be a clear indication for short-circuiting the duodenojejunal junction. I may mention also that the X-ray examination had not suggested duodenal delay, and, unless this is present, mere dilatation of the duodenum hardly calls for this more drastic operation.

CONCLUSIONS.

1. A consideration of these cases appears to indicate that chronic duodenal ileus may be secondary to gastroparesis alone.

2. In a smaller number of cases it may be due to compression of the fourth part of the duodenum by the superior mesenteric vessels and the drag of the mesentery.

3. It is doubtful how far it is a manifestation of general visceroparesis, but this may be responsible for it.

4. The dilatation of the duodenum, therefore, may affect primarily either the first or the third part of the duodenum.

5. The appropriate treatment in most cases is duodenojejunostomy. In a few cases, however, there is so pronounced a kink at the junction of the first two parts of the duodenum that gastro-enterostomy is likely to give the best results.

I am indebted to my former dresser, Mr. H. E. Blake, for the drawings.

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² KELLOGG, E. L., *Surg. Gynecol. and Obst.*, 1919, xxviii, 174.

³ HAYES, "Intestinal Stasis", *N. Y. Med. Jour.*, 1914, Jan. 24.

⁴ BLOODGOOD, *Jour. Amer. Med. Assoc.*, 1912, July 13.

TWO CASES OF STRICTURE OF THE BOWEL BY MISPLACED ENDOMETRIAL TISSUE.

BY T. B. MOUAT, SHEFFIELD.

I VENTURE to describe two cases of stricture of the gut due to invasion of its wall by misplaced endometrial tissue, because most of the previous work on this subject has appeared in journals devoted to gynaecology and obstetrics, and a wider recognition and knowledge of the condition by the general surgeon is desirable, as the lesions set up by these transplantations give rise to difficulty in diagnosis and treatment.

While grafts of true endometrial tissue appear to be derived from the uterine and less frequently from the tubal mucosa, difficulty and much argument have arisen from the possibility that very similar glandular inclusions may, in certain situations, result from developmental abnormalities of certain embryological structures, or from metaplasia of the serous lining of the abdominal cavity, or of the epithelial covering of the ovary in inflammatory lesions of these structures; and Sampson,¹ in view of this difficulty, has proposed the following classification in order to include all possible varieties of the condition.

1. *Direct or Primary Endometriosis*, i.e., misplaced endometrial tissue in the uterine wall which was demonstrated by Cullen² and other authors to have arisen from the direct invasion of the myometrium by the mucosa lining the uterine cavity, causing the well known adenomyoma of mucosal origin. A similar condition occurs in the wall of the tube from its invasion by the tubal mucosa.

2. *Peritoneal or Implantation Endometriosis*.—In this group implantation-like deposits of endometrial tissue are found scattered through the pelvis, similar in their distribution to the peritoneal implantations of cancer and, like the latter, often invading underlying structures.

3. *Transplantation Endometriosis*, in which endometrial tissue occurs in the scar of the abdominal incision after operation on the pelvic organs. Sampson states, in discussing this variety, that "he is convinced that the manipulation of the uterus and tubes incident to pelvic operations may at times detach uterine and tubal epithelium and cause it to be transferred not only to the abdominal wound, but also to the tissues of the pelvis. This is particularly true for endometrial tissue if the abdominal operation has been immediately preceded by a curettage".

4. *Metastatic Endometriosis*.—A group which includes extraperitoneal endometrial tissue in situations similar to the metastases from cancer of the pelvic organs.

5. *Developmentally Misplaced Endometrial Tissue*.—Sampson admits the possibility of such a condition, but states that "he has never been able to appreciate it".

The following two cases are examples of peritoneal or implantation endometriosis :—

Case 1.—Implantation endometrioma involving the ileum; resection with end-to-end reunion: adherent tubo-ovarian cyst on right side.

Mrs. H., age 36. No pregnancies. Complained of pain in the lower abdomen and of severe dysmenorrhœa. Menstruation had always been painful, and it was scanty and irregular up to the time of her marriage in 1911. After marriage she was

ill for some weeks with severe pelvic inflammation, and ever since then the loss has been profuse but still irregular in type (five to eight weeks). For the year preceding operation the dysmenorrhœa had been so severe that she had to lie up for the first day of each period, and she had also suffered from colicky pains in the lower abdomen. The motions were regular, and there was no constipation or difficulty with the bowels at the periods.

OPERATION.—June, 1924. The lumen of the ileum was found to be narrowed by a localized puckered depressed area which crossed the antimesenteric portion of the gut at a point about nine inches proximal to the ileo-cæcal valve. The appearance suggested that the lesion was the result of a localized healing tuberculous ulcer. About three inches of the gut were resected, and end-to-end suture with fine linen thread was performed. The appendix, which was kinked and contained a concretion, was removed. On

examining the pelvis the left appendages were found to be cystic and firmly adherent to the pelvic floor and back of the uterus. They were freed and removed. It was thought from the history that the pelvic lesion was the result of old gonorrhœal infection, and although on cutting open the specimen it was noticed that the contents were of a dirty brown colour, the only association which suggested itself between the lesion in the gut and that in the pelvis was that as the mucosa of the resected segment of intestine was intact, and its walls were obviously invaded from without, the gut had been adherent to the lesion in the pelvis and had subsequently freed itself.

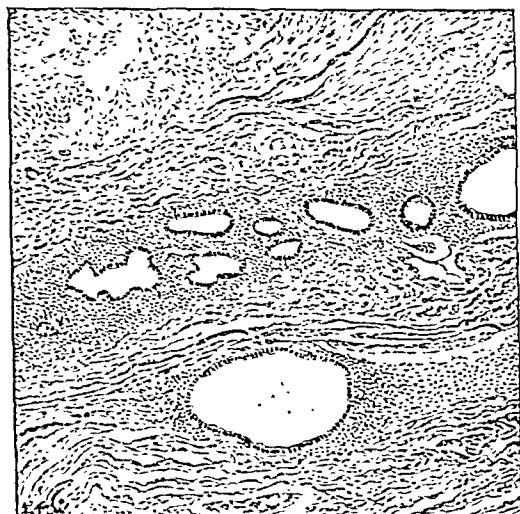


FIG. 46.—Adenomyoma involving ileum. Endometrial tissue in subserosa, muscular coat of ileum above. (Low power.)

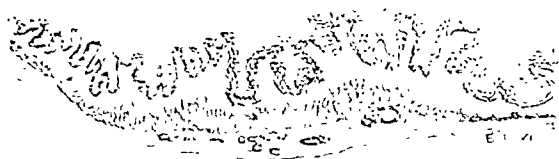


FIG. 45.—Adenomyoma of ileum. Hæmalum and eosin. ($\times 2$.)

The resected portion of the gut was examined by Professor Stewart, of Leeds, who reported that the muscular wall of the gut at the site of the lesion was hypertrophied and invaded from without by groups of glandular acini lined by low columnar epithelium and embedded in stroma of endometrial type (Figs. 45, 46).

The patient eighteen months after operation (Jan. 5, 1926)

reports that her dysmenorrhœa and pelvic pain are cured. The periods are regular and the loss is not excessive. She has no trouble with her bowels, and is working regularly as a school teacher.

Case 2.—Perforation of a tubo-ovarian blood cyst which simulated rupture of an extra-uterine gestation. At operation a stricture of the ileopelvic colon was found, and when subsequently resected proved to be an implantation endometrioma.

Mrs. S. P., 43, one child, age 19½. Her illness dates back to the pregnancy, during which she suffered from 'chronic appendicitis', and ever since she has been troubled with recurring attacks of 'inflammation' in her lower abdomen, for which she used to lie up for weeks at a time. Twelve years ago she was examined by a gynaecologist and told that she had a cystic adherent ovary, for the removal of which

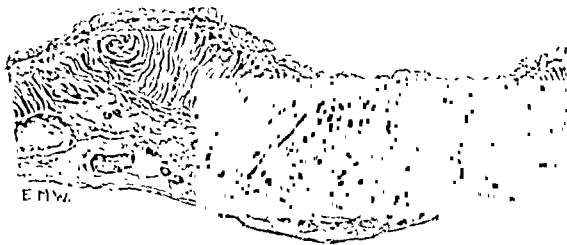


FIG. 47.—Adenomyoma of sigmoid. Masson's trichrome method. ($\times 2$.)

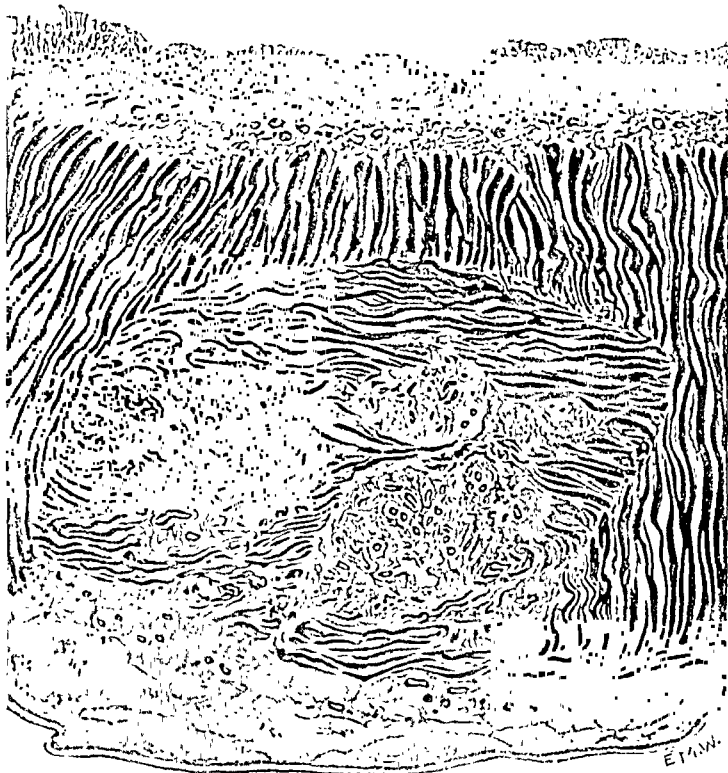


FIG. 48.—Adenomyoma invading sigmoid. Masson's trichrome method.

an operation would be necessary. She was not sent for to go into hospital, and a year later her own doctor examined her, and told her that "her inside had righted itself", and advised her "to let well alone". She carried on in ill health, with attacks of dysmenorrhœa and increasing loss at the periods, till before operation she was losing menstrual blood for three weeks each month, and the dysmenorrhœa had markedly increased for the twelve months which preceded her operation. For some

months she has also been troubled with increasing constipation, and noticed that this difficulty was greatly increased during the first week of each period.

The present illness commenced on Sept. 7, 1925, the second day of her menstrual period, with very severe pains in the lower abdomen and vomiting, and on the following day, when I saw her in consultation, she had a rapid pulse, a temperature of 101° , and dullness and rigidity in the lower abdomen.

OPERATION.—Free blood was seen through the peritoneum before it was incised, and a large amount of brownish-coloured stale fluid blood filled the lower abdomen, and had formed clots in the pouch of Douglas. The left tube and ovary were matted together, and fresh blood was found oozing from what appeared to be a ruptured extra-uterine gestation in the outer end of the tube. The left appendages were removed. No ovum was seen, and the specimen was unfortunately destroyed with the blood-clot. Before closing the peritoneum it was noticed that the apex of the ileopelvic loop of bowel was puckered, and its lumen narrowed by an area of induration and thickening which had all the characters of an early carcinomatous growth invading the wall of the gut.

The patient's condition did not warrant any further interference at that time, but six weeks later (Oct. 17) the abdomen was re-opened, and the affected segment of gut, with about an inch and a half of healthy bowel on either side of it, was excised. On examining the specimen the healthy condition of the mucosa and the limitation of the infiltrating tissue to the outer coats of the gut suggested that we had to deal with an implantation endometrioma and not with a carcinoma of the bowel. The gut was reunited by end-to-end suture with fine linen thread, and a 'safety-valve' cæcostomy was formed. A careful search revealed that no further implantations had resulted from the extensive peritoneal soiling by the contents of the blood cyst.

Recovery was uneventful; the patient has had two periods of three days' duration at twenty-eight-day intervals since the operation; the periods were practically painless, and she has had no difficulty with the bowels.

The histological examination of the specimen showed groups of glandular acini and stroma of uterine type invading the hypertrophied muscular coats; an opinion which was confirmed by Professor Stewart, to whom I am indebted for the beautiful sections stained by Masson's trichromic method and admirably reproduced in Miss Wright's water-colour drawings (*Figs. 47, 48*).

ETIOLOGY OF IMPLANTATION ENDOMETRIOMATA.

This appears to be simplified by the fact that the anatomical distribution of the implantations seems to exclude the earlier theories which ascribed them to aberrations in development of included Müllerian or Wolffian structures; while their sex and age incidence, and their histological and physiological characteristics, are all opposed to their being due to metaplasia of serous inclusions in areas undergoing inflammatory changes, and the most feasible explanation of their occurrence appears to be that advanced by Sampson,^{3,4} who first drew attention to the frequent association of these migratory adenomyomata with hæmorrhagic ('chocolate or tarry') cysts of the ovary, and suggested that the grafts of endometrial tissue made their escape from the abdominal ostium of the Fallopian tube during retrograde menstruation.

These migratory grafts select the ovary, but they may also fall into the pouch of Douglas and implant themselves on the pelvic floor, or on any of the pelvic viscera; and while further manifestations of their activity vary with their vitality, they show a general tendency to 'dig themselves in', and may manifest their function by the occurrence of menstrual bleeding into their

substance. The blood cysts which are thus formed in the ovary are very characteristic, and evidence of their former existence and perforation is so constantly associated with more extensive dissemination of the endometrial tissue and invasion of any of the pelvic structures outside the ovary that Sampson in his earlier writings expressed the opinion that additional vitality might be acquired by the grafted tissue during a primary lodgement and growth in the ovary, from which an invasive type of glandular tissue was released on perforation of the blood cyst which had resulted from its activity, just as a colloid or carcinomatous tumour might disseminate its contents under somewhat similar conditions.

Bailey⁵ disagreed with Sampson's view that the ovary might act as "an intermediate host, hot bed, or incubator", as his observations led him to believe that the implantations, wherever situated, were approximately of the same age, and resulted from the simultaneous deposition of epithelium of endometrial or tubal origin on the surfaces of various organs, after its escape from the tube during retrograde menstruation. In his view the 'chocolate' fluid contained in the ovarian blood cavity can have no active rôle in disseminating the grafts, because it merely consists of stale menstrual blood, phagocytes, and degenerated epithelial cells which are incapable of further growth.

In any case it is an accepted fact that the ovaries are the common site, their involvement is frequently bilateral (8 of 23, Sampson), and when affected they become embedded in adhesions which involve the pelvic viscera and simulate the results of pelvic inflammation. The stale blood contents of the ovarian cysts, the ragged, pitted appearance of the separated viscera, and the presence of discrete pelvic or bowel implantations, are, however, characteristic of the lesion under consideration.

Of Sampson's⁶ 12 cases in which implantations were found in the wall of the bowel, the rectum and sigmoid (including the appendices epiploicæ and mesentery) were involved in 8, the appendix in 4, and the small intestine in 2; and the presence of a blood cyst in the left ovary was noted in 6 of the 8 instances of implantations in the sigmoid and rectum, while they were found in the right ovary in all of the four cases in which the appendix was involved.

My own two cases and the examples recorded by Dougal⁷ and Leitch⁸ confirm Sampson's suggestion that the portion of the intestine situated near the affected ovary is more likely to be involved.

The lesions which result from the implantation of the endometrial grafts on the bowel vary greatly in character, and range from a tiny serous dimple or opacity to a puckered growth which closely resembles a carcinoma. Leitch (*loc. cit.*) records an interesting example of this simulation in which at operation "a small puckered area half an inch in diameter was noticed on the antimesenteric border of the most dependent part of the loop of the sigmoid flexure; underneath this area there was a very hard nodule in the bowel wall of the size of a Barcelona nut, which seemed from its appearance, and the sensation it gave to the finger, to be perfectly typical of carcinoma; and such was the opinion of Mr. W. Ernest Miles, who happened to be in the nursing home at the time". Mr. Rowntree subsequently operated on the gut lesion, but "before proceeding to the resection he opened the bowel

beyond the margins of the growth, and found that the epithelial layer was intact. A small portion of the bowel wall was therefore removed, and an end-to-end anastomosis performed". On microscopic examination the lesion proved to be an implantation adenomyoma of uterine type.

Sampson (*loc. cit.*) records a similar case in which an indurated area in the sigmoid just below the pelvic brim was found in association with an adherent cystic left ovary. The lesion of the gut was thought to be carcinomatous, and 8 cm. of the bowel were resected, with end-to-end reunion by suture. The tumour proved to be an adenoma of endometrial type, but the ovarian cyst was not examined histologically.

In my second case the apex of the ileopelvic loop of the bowel was puckered, and its lumen narrowed by a transverse depression which crossed the antimesenteric half of the gut, and was surrounded by an area of induration and thickening which closely resembled a slowly growing and retracted carcinoma. The affected part of the gut was not adherent to the pelvic lesion.

In my first case a somewhat similar condition was noticed on the antimesenteric portion of the ileum at a point about nine inches above the ileo-cæcal valve. The gut was not adherent, and it was somewhat distended above the strictured area. The peritoneum covering the transverse depression was opaque and 'stippled' in appearance, and the lesion was thought to be a localized healing tuberculous ulcer.

In two of Sampson's cases the implantation was similarly situated in the ileum, and a further case was recorded by Clara Stewart⁹ in 1920. This marked restriction to portions of the intestinal tract which frequently occupy the pelvis, and the appearance and distribution of the implantations in both my cases, rather suggest that the transference of the endometrial tissue had taken place during some earlier period in which the gut had been adherent to the pelvic lesion.

SYMPTOMS AND PHYSICAL SIGNS.

The symptoms and physical signs of the pelvic lesion may be characteristic, and we are chiefly indebted to Donald¹⁰ and to Sampson for their recognition.

The age incidence is from 30 to the menopause, and the women affected are usually sterile or have borne no children for a number of years, while they generally suffer from acquired and increasing dysmenorrhœa due to the bleeding which takes place into the invaded ovary and pelvic implantations during the menstrual periods. In one of my cases, and in several of the recorded instances of implantation in the bowel wall, a characteristic result of this menstrual hæmorrhage was the occurrence of intermittent obstruction during the periods. Rectal discomfort and tenesmus may only then be present, or are more marked at those times.

On pelvic examination the cystic and fixed ovary may be felt in the pouch of Douglas; while the uterus is fixed, and infiltration of the recto-vaginal septum, and of the wall of the rectum, may be palpable when present.

Where rectal pain and discomfort at the menstrual periods are prominent symptoms, examination with the sigmoidoscope should be helpful, for it would show that the mucosa is not involved in the lesion.

The majority of the grafts tend to die off, and are of histological interest only; but continued activity and progressive infiltration of the pelvic viscera may occur as long as ovarian tissue is present, and Sampson¹ has shown that invasion of the lymph channels may occasionally take place, and might explain the recorded instances¹¹ in which adenomata of endometrial type have been found in the groin and other situations in which the possibility of implantation and transplantation could be excluded.

TREATMENT.

While in particular instances the local lesions may require direct operative treatment, this is not generally considered necessary, and on recognition of the nature of the implantations the further procedure should be directed against their source in the pelvic viscera. Sampson's usual practice is to remove the uterus and both ovaries and tubes, and to disregard the implantations (including intestinal) except as they may be easily removed for histological study. The ovaries are removed as they are a possible source of further implantations, and because their hormones tend to perpetuate the activity of any heterotopic endometrial tissue; while the uterus is often retroverted and adherent, and myomas or other pathological conditions may be present, which in themselves indicate its removal. He admits, however,¹² that in special circumstances, as, for example, in young women who are anxious to have children, and in whom the disease is not extensive, he would be content with more conservative measures, and on occasion he has excised small endometrial deposits from the ovary. In five instances in which he had done conservative surgery the patients subsequently became pregnant, and three of them had children. He considers, however, that these cases must be followed closely, as undoubtedly in some of them the lesion will recur or progress so that a second operation may be required.

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THE CONTROL OF HÆMORRHAGE AFTER PROSTATECTOMY BY THE USE OF THE INFLATABLE RUBBER BAG.

AN IMPROVED METHOD OF RETAINING THE BAG.

By T. McW. MILLAR, EDINBURGH.

ONE of the dangers of enucleation of an enlarged prostate is hæmorrhage, the bleeding occurring chiefly from the ruptured veins in the walls of the cavity left after the prostate has been removed. Such bleeding may be profuse, and occurring, as it does, in patients who are often in poor condition, it adds considerably to the danger of the operation. In addition, the formation of clots in the bladder sometimes leads to trouble in the post-operative course by blocking the drainage tube in the bladder, so necessitating interference by the surgeon at a time when the patient is best left alone.

Many methods have been devised to control this hæmorrhage, but it would seem that none is so simple, so effective, and so safe as the use of a specially designed inflatable rubber bag, such as the Pilcher bag. This seems to be in common use in America, but British surgeons do not appear to be familiar with it, and the purpose of this communication is to draw attention to the advantages of such a bag, and to suggest a method of retaining it in position which is simpler, more effective, and more comfortable for the patient than any we have seen described.

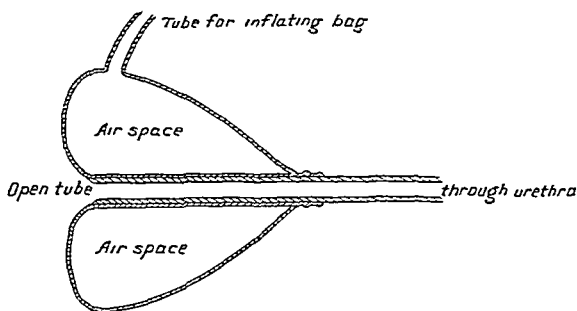


FIG. 49.—Sketch to show structure of the Pilcher bag.

In 1914 Hagner described a simple bag which he had designed and used to control hæmorrhage after prostatectomy, and Pilcher in 1917 modified and elaborated the design. Pilcher's bag is cone-shaped, and has attached to it two tubes, the one urethral and the other inflating. The urethral tube leaves the bag at the apex of the cone, but does not communicate with the cavity of the bag; instead it passes through the bag from the apex to the centre of the base, where it opens—into the bladder when the bag is *in situ*. The inflating tube is attached to the bag near its base, and opens into its interior (Fig. 49).

Method of Introducing the Bag.—Before the operation is begun a soft rubber catheter is passed into the bladder per urethram and left in position. The prostate is enucleated in the ordinary way, and the prostate cavity

examined to make sure that the removal has been complete. The end of the catheter is then pulled through the suprapubic wound, and the end of the urethral tube of the bag threaded over it and fixed there by means of a catgut stitch which transfixes both catheter and tube. The catheter is then withdrawn from the urethra, pulling the urethral tube after it. As soon as the end of the latter has emerged from the external meatus, it is disconnected from the catheter, and further drawn upon so as to bring the collapsed bag within the bladder. The bag is now inflated, or distended with sterile fluid by means of a syringe attached to the end of the inflating tube, and when sufficiently distended, as gauged by the surgeon's finger in the bladder, the tube is clamped. Further traction on the urethral tube now draws the bag into the prostate cavity, the surgeon's finger guiding it in and tucking down in front of it the shelf of mucous membrane, or any tags of mucous membrane

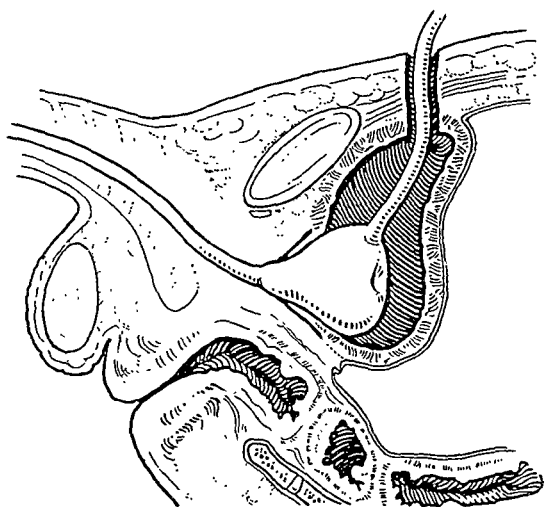


FIG. 50.—Shows the bag in position after removal of the prostate, the urethral tube passing along the urethra, and the inflating tube emerging from the suprapubic wound.

which formerly covered the vesical surface of the prostate. The urethral tube is now firmly pulled upon, and from that moment onwards, until the risk of further hæmorrhage is believed to have passed, the tension on the tube is never relaxed. From that moment also practically all hæmorrhage ceases. (*Fig. 50.*)

New Method of Retaining the Bag in Position.—When the bag has been inserted as described, there is still part of the operation to be completed, viz., the insertion of the suprapubic drain and the closure of the wound in the bladder and abdominal wall. It is therefore undesirable to remove the

sterile towels covering the patient, but at the same time necessary to fix the urethral tube temporarily in such a way as to maintain the tension on the bag. This is simply done by pulling on the urethral tube and stretching it until its end reaches below the patient's knees, where it is clamped to the patient's bed-sock through the sterile towels by means of an artery forceps. The bladder may now be gently washed out, the operation completed, and the dressing applied to the wound. The forceps holding the tube is now removed, the tube is held taut until the towels are removed, and then again clamped to the patient's sock, and the patient returned to bed.

A light weight-extension is now substituted for the fixed extension which has been employed up to this point, a weight of 1 to 2 lb. being applied to the urethral tube by means of a piece of string which passes over the bar at the foot of the bed, or over a pulley, though the latter is hardly necessary. The patient is thus left with the bag fitting snugly into the prostate pouch, and

securely kept there by a weight extension of 1 to 2 lb. exerted along the urethral tube, which passes from the penis down between the patient's thighs, causing him no inconvenience and allowing him to move his limbs freely without interfering with the tube or altering the pull on the bag. From the suprapubic wound there emerges the suprapubic drain, and alongside it the inflating tube, clamped (*Fig. 51*).*

If, after four, six, or eight hours or longer, the danger of hæmorrhage is believed to have passed, the pressure exerted on the walls of the prostate cavity can be immediately removed by disconnecting the weight from the urethral tube. The latter retracts to its normal length and then acts as an extra drain from the bladder, the end of the tube being passed into a urinal. If it is further desired, perhaps after waiting a few hours and no hæmorrhage having occurred, to deflate the bag, this is done by removing the clamp or ligature from the inflating tube. Should any hæmorrhage again occur, the

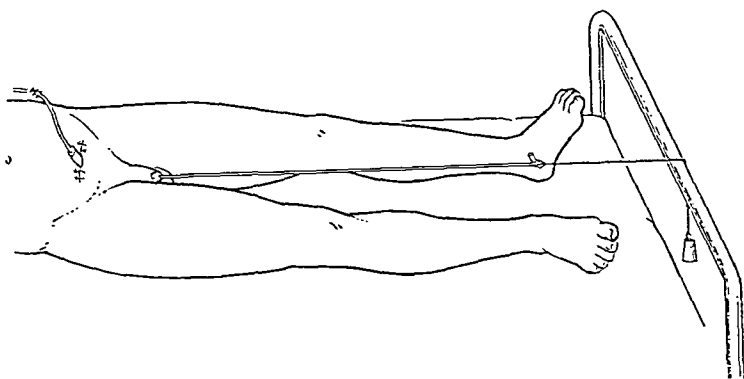


FIG. 51.—Illustrates the method described for holding the bag in position by means of a weight-extension applied to the urethral tube. The suprapubic drain and the inflating tube are seen emerging from the suprapubic wound.

whole apparatus can at once be brought into use by inflating the bag and again attaching the weight-extension to the urethral tube.

This method of retaining the bag in position seems to us more simple and effective than any of the other methods we have seen described. In practice we have found it very efficient and convenient, and infinitely more comfortable for the patient than some of the other recognized methods which we have tried, brief mention of some of which may be of interest.

Methods Previously Employed for Retaining the Bag.—Hagner suggested tying a piece of gauze firmly round the tube just beyond the penis, so that the gauze, coming against the end of the penis, prevented the tube from slipping back along the urethra, and, therefore, the bag from passing up out of the prostate cavity into the bladder. He stated that even this was not necessary, as the cut-off muscle tends to shut down on the tube and hold

* N.B.—In using this method two points require close attention: (1) Tension on the tube must not be too great: (2) The bag, when inserted, must be air-tight. If either point is overlooked, temporary incontinence of urine may occur as a result of over-dilatation of the sphincter urethre muscle.

the bag in position. We can hardly believe that the muscle would grip the tube sufficiently strongly to keep the bag firmly pulled down into the prostate pouch.

Pilcher fixed the tube to the inner aspect of the patient's thigh by means of strips of adhesive plaster. This method was tried in one of the cases under our observation, but it does not seem so simple and reliable or so comfortable for the patient as the method we advocate.

Various forms of wire cages have been recommended. These fit over the pubic arch or round the upper part of the thighs, and have a projecting portion passing down between the thighs, to which the urethral tube is tied. We have had experience of one such type of cage, and the patient found it extremely irksome.

Method of Removing the Bag.—As a general rule the bag may be removed forty-eight hours after operation, and this is accomplished in the following way: As the bag is removed by the suprapubic wound, it follows that the urethral tube has to be drawn back along the urethra and then up through the bladder. A considerable portion of the tube has been lying outside the urethra, and is therefore probably septic, and some precaution must be taken to prevent the introduction of any sepsis into the bladder. Two methods are suggested:—

1. Before removal is carried out, the external meatus is cleansed, the urethral tube pulled on, and divided with scissors just beyond the penis, thus removing the part of the tube which has been exposed. This means, of course, that the bag is sacrificed and cannot be used again.

2. The external meatus and the extra-urethral portion of the tube may be carefully washed with soap and water, antisepticated with spirit, and lubricated with catheter lubricant. In this way the danger of introducing sepsis may be reduced to a minimum.

The actual removal is simple. The bag is emptied by releasing the clamp on the inflating tube—if this has not already been done—or actually exhausted, if necessary, by suction with a syringe attached to the inflating tube. The suprapubic drain is then removed, and the bag drawn out after it by traction on the inflating tube. Finally, a de Pezzer catheter is inserted to act as a suprapubic drain. In this way removal of the bag can be carried out with very little discomfort to the patient.

Advantages of the Bag Hæmostat.—The advantages claimed for the bag hæmostat here advocated may be summarized as follows:—

1. It is simple, effective, and safe.
2. It is easily and rapidly introduced and easily retained by the method here suggested.
3. It is comfortable for the patient.
4. It is easily removed without pain or disturbance of the healing surface.
5. It tends to mould the prostate cavity and to press down over its walls any ring or strip of mucous membrane left at the vesicoprostatic entrance, thus hastening the epithelialization of the cavity.
6. It ensures the maintenance of a good lumen through the prostate cavity and into the anterior urethra, and so tends to prevent contraction and

partial occlusion of the bladder orifice, a troublesome complication which frequently occurs, delaying the recommencement of urination by the patient and sometimes necessitating the passage of a bougie. Looked at from this point of view, the bag helps to shorten the period of convalescence.

7. The simple method we suggest for retaining the bag in position by means of a light weight-extension applied to the urethral tube is, in our opinion, superior to any other method previously employed, and adds considerably to the usefulness of the bag hæmostat as an instrument for controlling hæmorrhage after prostatectomy.

Illustrative Cases.—The following notes are of five recent consecutive cases. All of them were average cases of chronic retention due to prostatic enlargement. Some had had acute retention and been catheterized on several occasions. All had a preliminary suprapubic cystostomy with insertion of a de Pezzer catheter for suprapubic drainage. In all the bag hæmostat was employed, being retained in the first case by means of an iron cage, in the others by the use of a light weight-extension as described.

Case 1.—Mr. O. Prostate removed about 14 days after preliminary suprapubic cystostomy. No post-operative hæmorrhage. Complained considerably of the discomfort of the cage till the bag was removed. Suprapubic drain removed in 10 days. Began to pass urine about 14 days after operation, leakage from the wound ceasing about the 20th day.

Case 2.—Mr. F. A semi-invalid on admission. Suprapubic prostatectomy 8 days after preliminary operation. No hæmorrhage after leaving theatre. Bag removed in 48 hours, suprapubic drain on 12th day. Passed urine the same night, and passed 70 oz. in the following twenty-four hours. Wound quite healed on 16th day. Left hospital on 27th day after operation.

Case 3.—Mr. B. Over 70 years of age. Prostate removed on 8th day after suprapubic drainage was established. No hæmorrhage. Passed urine on 12th day after operation, and wound dry on the 17th day.

Case 4.—Mr. D. In poor health. Had been in bed off and on for several months. Preliminary drainage for about 14 days. Prostatectomy—considerable hæmorrhage on removing the prostate. Hæmorrhage apparently completely controlled on inserting the bag. Urine passing from suprapubic drain perfectly clear the same evening. Drain removed 12th day. Passed urine the same day, and absolutely no urine escaped from the suprapubic wound thereafter.

Case 5.—Mr. McR. Suprapubic drainage followed by prostatectomy in 10 days. Little hæmorrhage, which ceased on inserting the bag. Passed urine on 12th day after operation. Slight leakage from wound for a few days thereafter, but left hospital with wound dry and healed on the 20th day after operation.

Other Methods Employed to Control Hæmorrhage after Prostatectomy: their Disadvantages.—

1. *Irrigating the Cavity with Hot Water.*—This method is now generally considered to be so ineffective that little need be said concerning it. The stream of hot water probably tends to remove the clots forming in the torn vessels rather than to stimulate their formation.

2. *Methods which Aim at Controlling the Bleeding by Ligature or Suture,* e.g., Thomson-Walker's open prostatectomy, and Fenwick's method of clamp and ligature, using a special speculum through which the bleeding points are seen.

The disadvantages of these methods are: (a) Any such procedure must add considerably to the time required to complete the operation. (b) In Thomson-Walker's method a very full exposure of the bladder floor is required. (c) Considerable skill and practice, as well as special instruments, are needed to carry out these procedures satisfactorily. (d) They may fail to control the hæmorrhage completely, in which case some form of packing has to be resorted to as well. (e) If a considerable fall of blood-pressure has occurred during the operation, bleeding may cease to a large extent; but reactionary hæmorrhage may occur later from vessels which have not been ligatured because they were not seen to bleed.

3. *Packing the Cavity with Gauze*, e.g., ordinary gauze packing; Barringer's method of using a sponge-holding forceps to keep the gauze plug forced into the prostate cavity; Horsley's method, in which gauze is packed round an in-dwelling catheter in a loop of linen thread attached to the catheter at two points several inches apart, and traction made on the catheter.

These methods may be criticized on the following grounds: (a) Ordinary packing does not always control the hæmorrhage, in which case repacking becomes necessary. (b) The use of gauze is said to give rise at times to an unusual amount of sloughing of the bladder and wound. (c) The removal of a gauze packing often causes considerable pain, and an unnecessary disturbance of the healing surface. (d) The use of gauze cannot be considered a clean method; the portion which lies in the prostate pouch and the end which is brought up through the suprapubic wound are continually soaked with urine—not a very suitable 'dressing' to keep closely applied to a healing surface for several days. (e) Barringer's method need hardly be criticized, as it is designed for use only in those cases where the patient has been found unable to tolerate a catheter in the urethra. (f) Horsley's method seems to the writer to be neither easy nor likely to be reliable, in addition to possessing the disadvantages common to the use of gauze in any form for this purpose.

I wish to express my indebtedness to Professor Fraser, of Edinburgh University, for the help and advice he has given me in preparing this paper, and for permission to publish the notes on cases.

HIGH OR THIRD-DEGREE PROLAPSE OF THE RECTUM.

BY K. W. MONSARRAT, LIVERPOOL.

THE purpose of this paper is to support the following propositions: (1) High or third-degree prolapse of the rectum is a true invagination. (2) The starting-point of this invagination is always about the junction of the pelvic colon and the rectum.

HISTORICAL.

The condition has not received much attention in the text-books.

Swinford Edwards refers to it as follows: "The patient usually complains of a constant desire to go to stool, and of various uncomfortable sensations in the bowel. Defæcation is accomplished with much straining, and discharges of mucus, perhaps tinged with blood, occur from time to time. In cases which have come under my notice the most marked and sometimes the only symptom has been a very copious discharge of mucus and flakes of lymph, resembling to some extent the profuse watery discharge characteristic of villous disease".

In Tillmann's *Special Surgery* the subject of prolapse of the invaginated colon is discussed, but the occurrence of invagination of colon into rectum without protrusion through the anus is not mentioned. With regard to prolapse of the invaginated colon, the author states that the condition is most frequently reported as a sequel to tumours of the sigmoid flexure.

Lockhart-Mummery does not refer in his text-book to any particular symptomatology associated with high rectal invagination.

Bodkin, of New York, defines 'third-degree prolapse' as follows: "The prolapse begins high up in the rectum or sigmoid flexure, and extends down into the ampulla of the rectum, but does not protrude through the anal orifice". He does not, however, describe any particular symptomatology.

Gant, of New York, devoted considerable space to the treatment of third-degree prolapse by operative measures, favouring excision of the mass below and fixation of the colon above.

It is in Harrison Cripps' book, however, that the clinical description is most complete. He says: "The upper part of the rectum is invaginated into the lower, but not to a sufficient extent to reach the anus. It can be understood how there is little difficulty in the diagnosis of prolapse when the bowel can be actually seen protruding from the anus; but in the third form of prolapse to which I have alluded, and in which there is no protrusion, the diagnosis is not so easy, and I would wish, moreover, to call special professional attention to this variety, for I am confident that it will occasionally afford an explanation of rectal symptoms otherwise unaccountable". In spite of what Harrison Cripps wrote, the clinical course of these cases is not as generally known as is desirable.

TYPICAL CASES.

High or third-degree invagination may occur as an acute condition, and need an emergency operation for its relief.

On June 3, 1920, I was asked to see a gentleman, age 46. He was somewhat stout and florid. Earlier in the day, not having had a normal action of the bowels, an attempt resulted only in the passage of a little mucus, after a good deal of straining and a sensation of something being in the rectum. About two hours later, again having the desire, he passed more mucus, this time blood-stained. Soon after this action he had severe abdominal pain, and this continued intermittently until I saw him about six hours after the first symptoms. He was then in severe pain in the lower abdomen, which was moderately distended; he had passed a considerable amount of blood per anum, but no flatus or motion. The distention and the character of the pain pointed to some form of low intestinal obstruction. Rectal examination revealed within reach of the finger a protrusion into the ampulla with an orifice at its apex; there was blood in the rectum, but no sign of growth. I had never heard of acute colorectal invagination; but the condition found had to be dealt with. He was removed to a nursing home, and I opened the abdomen shortly afterwards in the middle line above the pubis. An invagination involving the lower pelvic colon and the upper rectum was displayed and disinvaginated without any difficulty, and the colon was fixed by sutures to the parietal peritoneum in the left iliac fossa. The patient gave no more trouble, and had no further symptoms of the condition. He died from syncope this year, five years after operation, never having had any intestinal complaint of any sort.

The condition was new to me, and I have not met with it in so acute a form since.

The cases in which the symptoms are subacute and intermittent over a long period are well illustrated by the following history. The patient was a man, age 34. He was observant, and I asked him to write an account of his condition, which he did as follows:—

1. *Symptoms.*—Dull pain at base of rectum, like rheumatic pain, coming on suddenly and gradually getting more intense, as if pressure was being applied to a supersensitive spot inside the rectum near base of spine, combined with a faint feeling.

2. *Effect.*—Sometimes causes complete fainting if unable to lie down flat in time first. Also, sickness on the following day with intermittent vomiting over a period of up to twelve hours. In between periods of attacks severe colic pains with fainting have been experienced.

3. *Period of Attacks.*—Varies in frequency—say, from once or twice a month to once in six months.

4. *Times when Experienced.*—Pain comes on during the day when otherwise feeling fit, and at other times when in bed during the night.

5. *Forms of Relief.*—To lie down flat if possible and if not already doing so. Warmth such as a hot-water bottle applied to base of spine, also sometimes to abdomen or feet. Pain generally going off, or at least decreasing, on passing of wind, which is often impossible at the time until warmth is applied.

6. *Time when First Experienced.*—As far as I can remember, somewhere between the ages of 10 and 15, which would be getting on for twenty years now, the pain then coming on with constipation, as attention was drawn to it by my being found fainting in the lavatory.

7. *Time since at which Chiefly Affected.*—In 1914 and 1915, at the time I had an attack of appendicitis. My appendix was removed in September, 1915, after which I was free of the above attacks for some time, but they commenced again with slight attacks from about 1917 onwards till about 1920, and severe attacks sometimes combined with fainting between 1921 and 1924.

There have to be added to the above notes written by the patient, that he had noticed *mucus in the stools* fairly frequently and in association with the attacks, and that *abdominal colic* usually occurred with the rectal pain.

On rectal examination there was found to be definite telescoping of the bowel above into the rectal ampulla, and the protrusion was œdematous and hypertrophied. Hæmorrhoids were present, and the anus was very sensitive to examination.

On March 10 I fixed the pelvic colon. He has not been entirely free from symptoms since then. On April 1 and 8 he had flatulent pain in the abdomen, and a feeling of distention associated with a feeling of pressure in the rectum; the attack in each case went off at once on the passage of wind.

I have met with a number of cases similar to the above, and I think the condition is more common than is generally supposed; when one becomes alive to the significance of a group of symptoms and on the look-out for them, the condition of course turns up more frequently in one's practice.

The end of a colorectal invagination is likely to be eventual protrusion at the anus, and it must not be considered characteristic that the invagination always remains intrarectal.

As in the following case, the passage of mucus and blood is often the most prominent symptom:—

A female patient, age 31, a school teacher, was admitted to hospital on April 23, 1923. She had habitually been constipated until six months previously; about this time she began to have pain in the act of defæcation, and she also had pain in the perineum apart from the act of evacuation. The motions then became more frequent and more fluid than usual. Two months before admission she had first noticed 'blood and slime' in the motions, and this had continued. Her pain had been of an intermittent type, and had also been felt in the abdomen to the right side of the middle line above the pubis. Speculum examination showed the condition to be one of colon invagination into the rectum, with ulceration of the protruded bowel. In the ampulla was a large quantity of mucopurulent fluid.

What the primary condition leading to this rectal invagination may be is uncertain. An unusually lax mesocolon has been alleged. In some of my cases I have thought that anal spasm was connected with its onset; however that may be, it is a condition to be borne in mind when a patient comes complaining of pelvic and perineal pain, spasmodic in character and of a peculiar paralysing and distressing type, associated with the passage of mucus and perhaps blood. There are other rectal conditions which will produce very much the same symptoms, more particularly villous growths and polypi, but colorectal invagination must be sought for and excluded.

The following history is of interest with regard to the relationship between high prolapse and anal spasm:—

A gentleman, age 58, had had hæmorrhoids for years with occasional

bleeding. Of late he had had some abdominal pain. The first attack was two years previously, when he had an illness which was considered ptomaine poisoning, the chief symptoms being abdominal pain and the passage of blood and mucus by the bowel. The last attack began twelve days before he was seen, with diarrhoea and abdominal pain; the diarrhoea consisted of mucus and blood. He had since had, off and on, pain in the rectum itself, and a feeling as if the bowel was coming down. On the day when first seen I could make only an abdominal examination; he could not tolerate a rectal examination, and his own medical adviser had also been unable to persuade him to permit this. The anus was held in firm spasm, and all that could be ascertained was that there were external piles of long standing. Under anaesthesia an examination was made with the sigmoidoscope. The pelvic colon was crowded down into the rectum and highly congested; it bled when touched by the instrument. Growth in the colon and rectum was excluded. A barium meal was followed through, and there was no arrest or delay in the large bowel or rectum. This, then, is a case of colon invagination, and it is associated with anal spasm in a very marked degree. For the time being his doctor and I have agreed to have a periodic examination of the faeces and to watch the progress of his symptoms. At the time of the sigmoidoscopic examination he was free from complaints.

DIAGNOSIS.

I believe that if these cases are looked for the condition will be found to be not uncommon. I am aware that, before I appreciated the symptomatology and its interpretation, one met with cases of rectal hæmorrhage and mucus associated with pain in which, when growth had been excluded and ulceration not found, one was at a loss for a diagnosis. I suspect that some of these cases were instances of colorectal invagination.

Regarding differential diagnosis from rectal and colon carcinoma, the condition so closely simulates the common features of cancer that inspection through a sigmoidoscope is essential to its diagnosis. Its clinical course, as compared with that of carcinoma, is distinguished by its intermittency. Instead of the daily small stools of cancerous ulceration, with mucus and blood, there are intervals of complete freedom from any discomfort which may extend to months.

The condition for which it is most likely to be mistaken clinically is 'mucous colitis'; but no surgeon to-day would make a diagnosis of mucous colitis without a sigmoidoscopic inspection. This will at any rate exclude high prolapse, even though the changes in the pelvic colon in mucous colitis are so often inconspicuous.

TREATMENT.

The treatment of colorectal invagination is by *colopexy*. I have the following remarks to make about this operation:—

1. Disinvagination may be difficult. In one of my cases I was not satisfied when the operation was finished that disinvagination was complete. At the bottom of a deep male pelvis, with the wall of the gut œdematous and

somewhat rigid, I felt that recurrence was a possibility. I had to operate on this case a second time, and found the solution of the difficulty: complete disinvagination was impossible without the aid of an assistant's hand introduced entirely into the rectum. Probably this is a very unusual difficulty.

2. Fixation to the anterior abdominal wall should not be done. The site for fixation is in the left iliac fossa as low as possible. Fixation should be made after incision of peritoneum and iliacus fascia over an area not less than 6 in. in its long axis. Muscular bands of the colon are sewn to the edges of this incision, and about twelve stitches are required. I prefer silk.

3. The operation cures high rectal prolapse if all the slack of the bowel is taken up, and if sufficient care is taken over the actual fixation.

Fixation of this kind is a perfectly satisfactory method of arresting the prolapse; but colopexy has been somewhat out of favour with surgeons because a few stitches have been relied upon to attach the bowel to the parietal peritoneum.

Considering how careful one has to be in making a permanent colostomy to take in all the proximal slack of the colon if a prolapse is to be avoided, it is surprising that prolapse of colon into rectum is not a more common accident. It is prevented by the anchoring of the bowel at the sacral promontory and below. In prolapse these moorings give and become slack. As far as my observations have gone, it would seem that that portion of gut where pelvic colon becomes rectum forms the apex of the invagination, and that as this advances into the rectal ampulla the latter is progressively turned outside in. In other words, the type of invagination appears to be the analogue of ileocecal intussusception. I have not met with any case of colorectal invagination analogous to the ileocolic intussusception of the other end of the large bowel.

SUMMARY.

I would sum up the clinical facts regarding colorectal invagination (the so-called high or third-degree prolapse) as follows:—

1. It seems to be connected in some cases with a condition of anal spasm.
2. It may occur as an acute condition causing symptoms of obstruction.
3. Anatomically it is a turning-in of the rectum into itself, commencing at its upper end.
4. As a chronic condition its main symptoms are discomfort and difficulty in defæcation, a peculiar rectal pain described by patients as paralysing, and the evacuation of mucus and usually blood.

THE SURGERY OF THE LUNG.

By JOHN T. MORRISON, LIVERPOOL.

THE surgery of the lung has attracted attention from a much earlier date than would at first sight seem probable. It is stated that the lung was resected in man as far back as 1884,¹ but I have been unable to trace the exact reference. Since then a large amount of experimental work has been done, to shed light upon the problems peculiar to operative work in this field. In the early days sepsis led to the speedy death of almost every animal that survived the shock of the operation, and proved a terror even in the hands of so great a surgeon as J. B. Murphy.² In 1909 Sauerbruch³ reported the survival of only 4 animals out of 38 operated on.

In the minds of almost all, surgeons and experimenters alike, the risks of an open pneumothorax loomed large. Accumulated experience of war wounds, however, has taught us that expensive and complicated methods are not necessary to cope with this danger, and that, while a 'sucking' wound is of grave omen, a widely opened thorax permits of extensive operative procedures on the lung in comparative safety. Since those days a controversy has raged as to the exact conditions under which respiration is carried on in such cases, and as the question is one fundamental to our subject it must be briefly alluded to.

One school insists on the pliability of the mediastinal curtain, and shows that alterations of pressure on one side are automatically and tolerably accurately reproduced upon the other. The corollary of such a position is of course that, given the cross-sectional area of the trachea, and the vital capacity of the individual, it is merely a mathematical problem to determine how large an opening may be made, in either one or both sides of the thorax, before the lungs cease to function, and death from asphyxia results. The area of such openings has been variously computed at from 64 to 102 square centimetres. Of this line of argument Graham, of Washington, is one of the leading exponents.⁴

Graham, however, has to face the undoubted fact that large thoracotomies have frequently been made, far exceeding the highest estimate of the area of safety. Pierre Duval, whose reputation as an operator on the chest was firmly established during the war, declares indeed that safety lies in securing a very wide opening into the chest, and as complete collapse as possible of the lung upon that side.⁵

It is possible that the truth lies somewhere between the two positions. The mediastinal curtain is no doubt a structure most sensitive to variations in pressure; but even in health it surely has a limit to its pliability. On the other hand, may it not be that Duval does not fully realize to what an extent he diminishes the opening into the chest when he puts his hand in, or when he

draws the lung out, and that every manipulation of the lung tends to fix the mediastinum, and so interfere with the transmission of positive pressures to the unopened pleura ?

EXPERIMENTAL METHODS.

For the last two and a half years I have been investigating some of the problems involved in the removal of lung tissue, and the technique necessary in such operations. I was interested, too, in the measures adopted by nature to readjust the relations of the intrathoracic organs. This experimental work has been done entirely on rabbits. The anæsthetic used was simply open ether given on a towel.

I began by making a vertical incision through the costal cartilages from the 4th to the 9th, but soon gave this up in favour of an intercostal incision in the 4th space, extending from close to the sternum to nearly the posterior axillary line. The wound is widely opened by a mechanically actuated self-retaining retractor. A few moments' delay after opening the pleura allows the respirations to quieten down. The lung can then be seen partially collapsed, and easy access is had to the root. It was soon found that with the chest thus widely opened, once the anæsthetist had gained a little experience with the animals, no difficulty arose that could be traced to the open pneumothorax. Small portions of lung were removed, and later whole lobes, without difficulty and without ill-effect. At first I was careful to suture pleura, invaginating the wound as war experience seemed to indicate was essential ; but owing to the awkwardness of delicate manipulations in the confined space of a rabbit's pleura I abandoned this step. Results were in no way different. There was no single case of sepsis from first to last, and I attribute the importance of suturing the pleura in war wounds to the invariably infected nature of the trauma. In these rabbits, on the contrary, even the primary divisions of the bronchi were always found to be sterile. The method finally adopted was simply to crush the base of the piece of lung to be removed with a clamp, and ligature with No. 1 ten-day catgut. The chest was closed, of course without drainage, with interrupted through-and-through stitches of chromic gut encircling adjoining ribs.

When now I came to resect a whole lung, I found myself invariably unsuccessful. In every case the animal died either at the moment of clamping the pulmonary root or else almost immediately after. The respirations at once became very deep and irregular and speedily ceased, usually in full inspiration, the chest gradually subsiding as the animal died. The heart continued to beat for some time. In one case only could I find any local condition that could have had any bearing on the fatality—namely, in one rabbit in which a certain amount of blood had been aspirated into the main bronchus of the opposite side.

It then occurred to me that the cause of the trouble was a nervous interference with the reflex of respiration by powerful stimuli passing from the grossly traumatized pulmonary root, via the anterior and posterior pulmonary plexuses. I therefore divided the vagus in the neck, on the first occasion three weeks beforehand, but later on as a first stage in the main operation. The result was astounding, for one could then remove with ease the whole lung,

without any change in respiration or heart-rate sufficient to cause the least anxiety. In one case a vagus block with novocain appeared to give as complete security as division of the nerve, but preliminary administration of atropine failed to influence the mortality. Since this simple prophylactic has been adopted, I have had no deaths from complete resection of one lung, except in one case where the ligature on the root slipped, and bleeding quite uncontrollable in the tiny space of a rabbit's pleura followed. The animal died the following night.

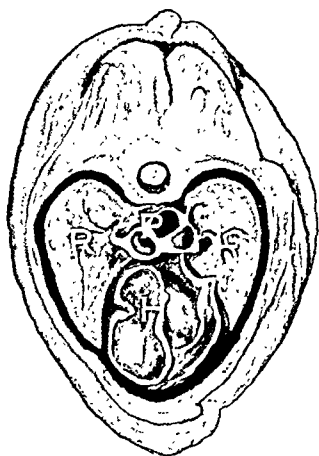


FIG. 52.—Transverse section of adult rabbit: normal control. R, Right lung; L, Left lung; H, Heart; P, Posterior mediastinum.

affected, and indeed they seemed particularly well nourished and quite vigorous. Attempts on the part of the laboratory attendant to catch them, when they were let loose, resulted in considerably more dyspnoea on the part of the huntsman than on the part of his quarry.

The anatomical and histological changes found are most instructive. The animals were killed at intervals varying from three to six months after operation, and the specimens prepared as follows: Immediately after being chloroformed, the femoral artery was opened, and 10 per cent formalin injected until the twitching of the muscles all over the body showed that the animal had been thoroughly infiltrated. It was left lying in a weak solution of formalin till thoroughly hardened, and sections were then carefully cut.

During life there is strikingly little asymmetry of the chest to be seen, but when sections are studied it will be noticed that the operated side is considerably smaller than the other. This appears to be brought about in various ways. In the earlier cases where the cartilages had been divided, the posterior cut ends slid forwards over the anterior ends. In those where an intercostal incision was employed there was crowding together of the ribs, and no doubt

RESULTS OF EXPERIMENTAL OPERATIONS.

The results of these operations may be looked at in two ways: first of all as regards the effect on function; and, secondly, as regards anatomical and histological changes in the remaining viscera. The well-being of the animals did not appear to be in any way

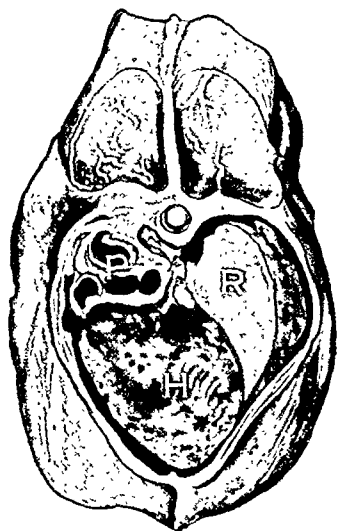


FIG. 53.—Transverse section of adult rabbit six months after left total pneumectomy. The drawing shows a reverse view. Note how the right half of the thorax is occupied by the heart (H) and great vessels (P). R, Right lung.

some accompanying scoliosis. In addition to this, the size and relationship of the remaining intrathoracic structures are altered, so as to fill to some extent the place of the lost lung.

Of these, the part played by the heart is a difficult and important one. The impression gained from a study of the cross-sections (*Figs. 52 and 53*) would suggest that there is enlargement of the organ; but observation of a number of controls prepared as nearly as possible in the same way shows considerable variations, or apparent variations, in normal animals both in the size of the heart and in the thickness of its walls. Although I personally consider that the wall of the right ventricle is never so thick as after pneumectomy, the degree of difference in some of the controls is not such as to make the fact self-obvious. After all, the available channels of escape for the blood from the right ventricle are immediately diminished by anything up to 50 per cent, and hypertrophy, one would

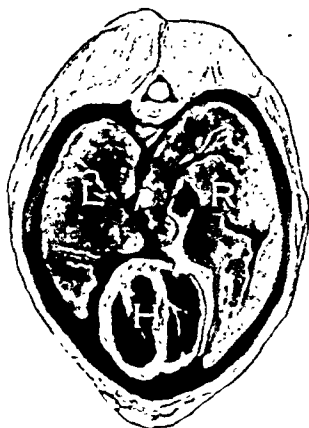


FIG. 54.—Transverse section of adult rabbit: normal control. The drawing shows a reverse view. R, Right lung; L, Left lung; H, Heart.

think, must follow, or dilatation and heart failure inevitably result. As a matter of fact, the researches of Heuer and his associates have shown that the output of the heart after total pneumectomy is increased.

A study of the cross-sections of the whole thorax shows that the heart lies close to the ribs on the left side of the chest; but if its relationship to the middle plane is compared in the two transverse sections, it is clear that there is surprisingly little displacement of the organ.

In regard to the lung, several interesting points arise. It is very striking how the posterior mediastinum is pushed over to the operated side by the lower lobe of the remaining lung (*Figs. 54 and 55*). In a specimen of long-continued collapse of the left lung in man in the pathological museum of the University of Liverpool, it is most instructive to see how a somewhat similar change has taken place. The upper lobe of the right lung has pushed the mediastinum—the superior mediastinum—before it as it has passed in front of the great vessels and the upper part of the heart over to the collapsed side.

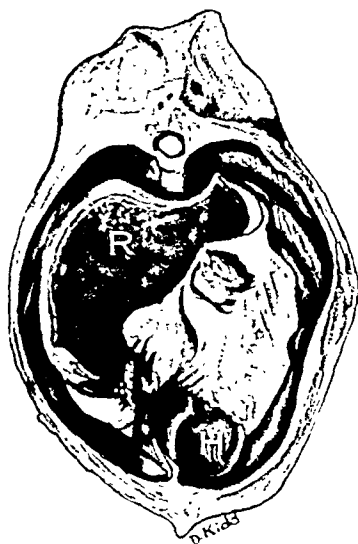


FIG. 55.—Transverse section of adult rabbit six months after left total pneumectomy. This section has unfortunately been cut slightly lower than *Fig. 54*, so that only the apex of the heart is seen. The characteristic bulging of the base of the right lung into the left thorax is well seen. R, Right lung; H, Heart; D, Diaphragm covered with fat.

upper part of the heart over to the collapsed side.

It is claimed by Kawamura⁷ and Da Fano⁸ that there is an actual hypertrophy of the remaining lung; but, to say the least, this appears doubtful. Two types of change are seen to take place, but both would seem to be of a pathological rather than of a physiological order.* In some a development takes place analogous to so-called compensatory emphysema (*Figs. 56 and 58*), although the capillary vessels in the alveolar walls are for the most part well preserved. The patchy character of this change is curious (*Fig. 58*).

In other sections of the lung, and these the more numerous, an intense vascular engorgement is found (*Fig. 57*). Careful study of this type shows the air spaces on the whole increased in size but

diminished in number in any one field. The epithelium lining them is greatly

stretched, the nuclei being few in number and far apart. The arrangement of the blood-vessels does not suggest new formation of capillaries, but rather a great distention and thinning of those which already exist—so much so, indeed, that in many instances the vessel walls are very hard to distinguish, and the microscopic appearance is that of sinusoidal tissue. The presence of many granules of blood pigment would bear out the above interpretation, granted the very natural assumption that this intense engorgement leads to many small hæmorrhages. It was pointed out to me by Professor Ernest Glynn—to whom I am indebted for much helpful comment—that it would probably be found that the emphysema occurred in the less well-supported parts of

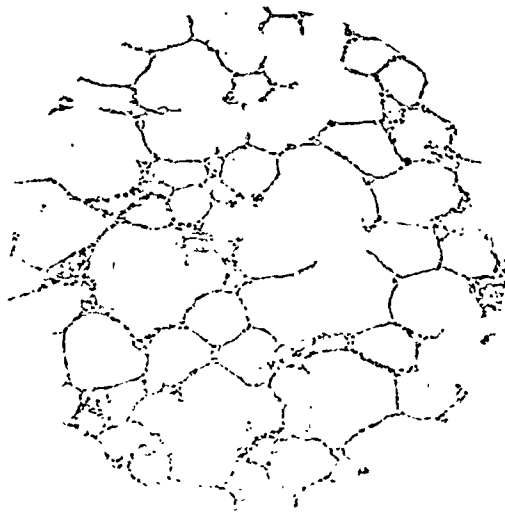


FIG. 56.—Well-marked emphysema of remaining lung after total pneumectomy.

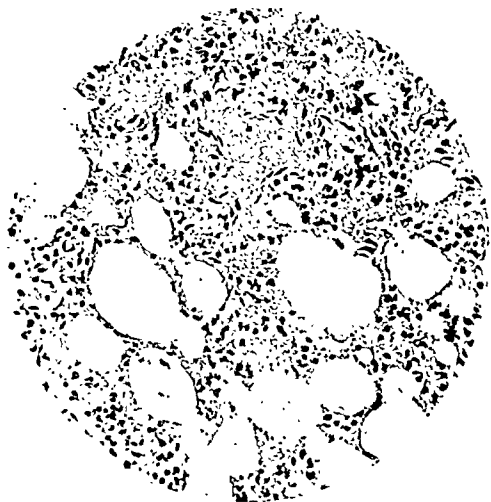


FIG. 57.—Remaining lung after total pneumectomy, showing intense engorgement and thickening of the alveolar walls.

* It is perhaps only fair to Da Fano to state that the animals used by him were only ten weeks old, and it is possible that true hypertrophic changes might occur at this age, whereas in the adult animals used in my experiments such recuperative efforts on the part of nature might well fail.

the lung, the congestive changes in other areas. This suggestion I have been able to confirm. It is stated by Da Fano that acute vesicular emphysema supervenes throughout the whole lung within three days of the operation. If it be so, it is noticeable that the animals show no striking respiratory distress during this period.

Lastly, the specimens suggest that there is an increase of fat, both in the superior and posterior mediastinum. This third method of obliterating dead space is most convincingly demonstrated in *Fig. 55*.

The empty pleural cavity is, of course, to begin with, filled with air; but in the course of two to three weeks, as has been shown by Heuer following up these cases radiographically, the air is mostly absorbed. In my specimens the anterior or ventral portion becomes largely obliterated by fine adhesions, while the dorsal part tends to remain free. This may be because any blood that is left in the pleura will naturally accumulate ventrally, where it will, in time, induce a plastic pleuritis. In no animal was any fluid found post mortem. In one case of partial resection of a lobe, three weeks after operation a long thread-like adhesion running from lung to diaphragm was found. The lung itself was so soundly healed that even microscopically it was extremely doubtful where the resection had been done. In complete pneumectomies the stump of the root of the lung becomes embedded in fibrous tissue and covered with smooth pleura. In no case was there any leakage from a bronchus.

This work confirms in its leading features the results of Da Fano, and of Heuer and Dunn of the Johns Hopkins Hospital. The latter carried out their work on dogs, using intratracheal pressure anaesthesia; the former operated upon rabbits, the method of anaesthesia not being stated. Neither seems to have had trouble with shock as I did in performing total pneumectomy on rabbits, and, so far as one can judge, the essential difference in technique lay in the disposal of the hilum. In the larger animals Heuer was able to isolate and tie separately the pulmonary artery and veins. The bronchus was sometimes subjected to crushing. Da Fano simply applied a mass ligature of silk to the whole root of the lung, but without preliminary clamping. It may be that these methods inflict less violent, or perhaps less sudden, trauma on the nerve plexuses in this region, and that this accounts for the success of these workers.

Nevertheless, out of my failure a striking fact has come, namely, that

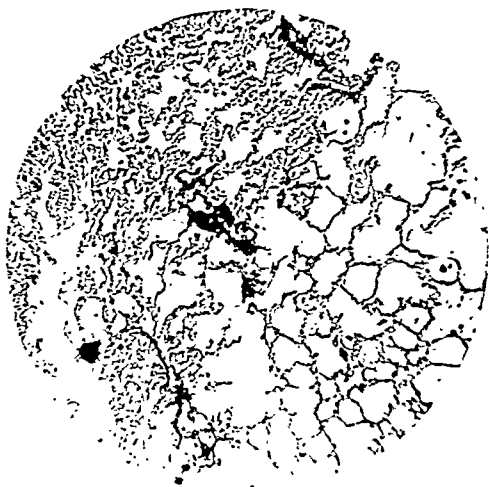


FIG. 58.—Section showing patchy distribution of emphysema in remaining lung after total pneumectomy; adjoining lobules show respectively a practically normal appearance (N) and well-marked emphysema (E).

by vagus blockage I could prevent a death which otherwise ensued with certainty, and it may be that this observation will find a useful application in the human subject. Lilienthal tells us that, even in excision of a single lobe in man, shock is a factor to be seriously reckoned with. Partly, no doubt, this is due to trauma inflicted on the chest wall; but this he has already tried to eliminate by infiltration and intercostal blockage with local anæsthetics. There remains the factor of shock due to intrathoracic trauma, and it is clear from his experience that anything which will diminish this risk will go far to improve the results of operation. Here the greatest possible delicacy in handling the hilum, and vagus blockage, would appear to go hand in hand. In a private communication from Morrision Davies, he tells me that he has already made use of this procedure in a case of partial pneumectomy in man with a very satisfactory result.

Finally, I would draw attention to the extreme simplicity of the administration of the anæsthetic, and to the fact that the thorax remained widely open for many minutes without serious ill-effect on heart or respiration. The size of the opening was diminished only by the insertion of instruments, except at the moment of tying the ligature.

APPLICATION OF THE EXPERIMENTS TO MAN.

The gulf between these operations and the application of the experimental results to man is, I fear, both wide and deep. To a certain extent, it is true, the margin of safety is often increased in man by adhesions of lung to chest wall, or increased rigidity of the mediastinum; but on the whole the scales are weighted heavily against the surgeon by the fact that in disease the human bronchi are so frequently, if not invariably, infected. To cope with this, many expedients have been devised, such as the application of grafts of lung tissue to the cut bronchus, drainage directly to the surface through a rubber sleeve, and even the eventration (if we may use such a term of a thoracic structure) of the infected stump. Infection still remains, however, one of the gravest risks in pulmonary surgery.

The most extensive record of the surgery of the lung in civil practice that I have been able to find is that of Lilienthal.⁹ In the operative treatment of bronchiectasis a heavy mortality—well over 50 per cent—proves the need for further advances in technique before surgical methods can make any real contribution to the treatment of this condition. The chief causes of death were first shock, second sepsis. The whole lung has been resected for unilateral tuberculosis by Stretton, Tuffier, Doyen, Lowson, Sonnenburg, and Macewen—by the latter on four occasions. In 1906¹⁰ he described the case of a man whose left lung was riddled with tubercle. It was completely removed, and I am informed by Mr. John Macewen that this man is still alive and is doing light work. Heidenhain¹¹ reports the removal of the lower lobe of the lung for bronchial fistula, and local resection of lung for a tumour of the chest wall adherent to visceral pleura. Kummell¹² removed the whole of one lung for a primary carcinoma, but lost the patient six days later from an acute bronchitis affecting the remaining lung.

In all the instances above quoted one cannot but be struck by the great

gravity of the conditions dealt with and by the grievous mortality. But is it not so with all new procedures? It is only as diagnosis is made earlier and with greater accuracy, while at the same time the knowledge of pathology grows and technique improves, that the mortality falls. Nothing could be further from the writer's mind than the idea that surgery is immediately to supply the appropriate treatment for local diseases of the lung. On the other hand, enough has been done to indicate that in this sphere, too, closer co-operation between physician and surgeon will lead to the greater benefit of the patient. It has been said by Lilienthal¹³ that we have at our disposal in exploratory thoracotomy a simpler and more effective method of diagnosis than in exploratory laparotomy, while at the same time, if no further operative procedures are undertaken, the resulting invalidism is much less. Such operations, too, will open up a way to the knowledge of that 'pathology of the living' which has done so much to advance the treatment of diseases of the alimentary system. May it not equally be the prelude to discoveries that will bring relief to those who suffer from hitherto incurable diseases of the lung?

Acknowledgements are due to Professor J. M. Beattie, in whose laboratories the work was done, for every facility offered; and to Mr. Douglas Kidd, of the University Department of Pathology, for the illustrations.

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TREATMENT OF CEREBRAL TUMOURS.*

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IN the following brief survey of a personal experience of cerebral tumours, I shall deal exclusively with the operative treatment of true neoplasms, taking no account of those cases of tuberculoma, syphiloma, and other conditions which may give rise to similar or identical symptoms. As to treatment other than operative I have no remarks to make, seeing that any such can only be palliative even in intention. At the present time all forms of radiotherapy have been disappointing in their results, although in a few instances the employment of radium combined with operation, i.e., the burying of radium in a glioma, has seemed to modify the natural course of the case appreciably.

Classification of Cerebral Tumours.—Intracranial tumours may be classified regionally or histologically, but from the surgical standpoint a grouping which combines the two is convenient. For the purposes of this communication I shall consider only the following groups: (1) *Cerebral gliomata*; (2) *Cerebellar tumours*; (3) *Endotheliomata*; (4) *Cerebellopontine tumours*; (5) *Pituitary tumours*.

The grouping of the gliomata according to their clinical behaviour and histological characters is beginning to be possible, and is of great importance from the point of view both of treatment and prognosis. There are, for example, those which undergo spontaneous cystic degeneration, where little can be found even microscopically of formed tumour structure, and where there is little or no infiltration of the surrounding brain. These are most often found in the cerebellum, and they may pursue a clinically benign course. Others are firm, solid, almost circumscribed tumours, having the appearance, at least to the naked eye, of being encapsuled: they are sometimes capable of removal with apparent completeness. The commonest variety, however, is the infiltrating, rapidly growing kind. In the future some definite histological differences may allow of a more scientific classification; but so far as my experience goes at present these three varieties resolve themselves into clinical groups, clearly demarcated in their history, course, and therapeutic requirements.

When planning an operation for an intracranial tumour, it is necessary to know as nearly as possible: (1) Its exact situation; (2) Its nature; and (3) The degree of intracranial pressure to which it may already have given rise. Unhappily even to-day, in the majority of cases so much time has already been lost before surgical aid is sought that it is the general

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intracranial pressure which governs the situation, and this regrettable state of affairs must persist so long as students are taught to repeat, parrot-wise, that the symptoms of cerebral tumour are "headache, vomiting, and optic neuritis". This trinity of symptoms is in reality indicative of impending death, and in the majority of cases marks the fact that the time for radical treatment, even if that had ever been possible, has passed by.

Diagnosis.—The diagnosis of cerebral tumour can in a very large proportion of cases be made, and ought to be made, before the onset of severe pressure symptoms, and this, speaking generally, will be commonly done only when the general physician has familiarized himself with the appearance of an optic disc which exhibits the earliest stages of papillœdema. The electric ophthalmoscope affords a means by which any practitioner is able to inspect the optic discs. In many instances, again, cerebral tumour can be diagnosed even when the discs are perfectly normal—for example, tumours of the cerebellopontine angle and endotheliomata affecting the motor, sensory, or visual cortex. The existence of any considerable degree of intracranial pressure obscures localization, forbids immediate radical treatment, and seriously prejudices the patient's prospects.

Apart from the vital question of intracranial pressure, there are two fundamental points which ought to be decided, in so far as it is possible to do so, before any operation is undertaken—namely, the exact situation and nature of the tumour.

Localization.—This must, I think, remain the special province of neurologists, at least until physicians in general realize that anyone may become capable of localizing a tumour who, with a working knowledge of the anatomy and physiology of the brain, will take the trouble to investigate the details of the history of the case, and make a systematic examination for all the well-known signs of impairment of function. It is not from want of knowledge but from failure to apply knowledge that most mistakes are made. It is astonishing to hear, as I have heard, the statement that mechanical means of diagnosis, like ventriculography, are required because only about 30 per cent of cerebral tumours can be localized by neurological signs. Happily this is very far from the truth, and from my own experience with my colleagues at the National Hospital for the Paralysed and Epileptic I can say confidently that the percentage is nearer 90 than 30. This being so I have naturally had little experience of ventriculography; but that experience, such as it is, together with such information as I have been able to derive from a study of the literature, does not encourage the hope that much is to be expected of ventriculography as a means of localization.

Nature of the Tumour.—In this respect we are not yet on such firm ground as with localization, but the nature of the tumour can often be predicted correctly. The grounds upon which an opinion can be based are:—

1. Its situation. Cerebral tumours are rarely any but gliomata or endotheliomata. In the frontal and post-central regions gliomata are twice as common as endotheliomata: in the occipital lobe six times as common; and in the temporal lobe thirteen times as common. Cerebellopontine tumours are mostly neurofibromata: pituitary tumours are most commonly adenomata; and cerebellar tumours are almost invariably gliomata. Leaving out

of consideration the cerebellopontine and pituitary tumours, the gliomata constitute 69 per cent and the endotheliomata only 20 per cent of the total number.

2. The history. Naturally a history extending over several years suggests a benign tumour; but a brief history does not, on the other hand, mean that the tumour is not benign, for a very slow-growing tumour may for years produce no symptoms at all, or the initial symptoms may have escaped the notice of the patient and the observation of his physician. It is not, however, only the length of time that symptoms may have existed which is important, but the rapidity of their progress. It is, I am convinced from experience, possible for a glioma to have existed for years, and then to take on active growth, so that signs of impairment of function manifest themselves in rapid, steady, and orderly sequence. It is not easy to distinguish between the symptoms due to encroachment of the actual tumour and similar symptoms caused by hæmorrhage into or œdema around the tumour. The latter, however, are always more rapid in onset, more variable in their character, and not so steadily progressive in their course.

Lesions other than true neoplasms cause symptoms indistinguishable from those of tumour, but with these I am not now concerned, except to point out that :—

1. Localized syphilitic and tuberculous masses are, in my experience, very rare.

2. Chronic abscess simulating tumour may be diagnosed from the presence of a possible source of origin in the history or in some existing septic focus, together with the condition of the cerebrospinal fluid. In my experience an abscess rarely or never exists in the presence of a perfectly normal cerebrospinal fluid; but, on the other hand, fluid similar to that found in abscess cases is sometimes present in cases of glioma. Hydatid cysts are, in England at least, exceedingly rare. I have encountered only one example amongst some hundreds of cases operated upon for cerebral tumour.

Radiography sometimes gives information, by showing the presence of opacities in a meningeal tumour or the shadow of a tuberculoma, or changes in the bone overlying an endothelioma, whilst of course the existence of a palpable bony thickening of long duration, coupled with symptoms of an intracranial tumour in that situation, makes the diagnosis of endothelioma certain.

To sum up, it may confidently be stated that in the vast majority of cases an intracranial tumour can be accurately localized, and in more than half the cases its nature can be correctly stated.

Scope of Operation.—The ideal operation aims at complete removal of the tumour, without producing any further neurological damage, and by an approach which leaves the patient without a cranial defect. The cases in which this ideal is possible of attainment are unhappily few in number. The conditions cannot be fulfilled in the case of any infratentorial tumour, because a cranial defect necessarily remains, even in the rare cases where the tumour is of such a nature and so placed as to be capable of complete removal without damage to the surrounding nervous structures. They can rarely, if ever, be fulfilled in the case of tumours in the pituitary region, since such tumours, in

my experience, are never capable of complete removal. In the case of the gliomata of the cerebral hemisphere the nature of the tumour and the stage to which it has advanced when the operation is undertaken almost invariably render complete removal impossible, even if that could be achieved without causing further neurological damage, and if the state of the general intracranial pressure were such as to permit of the operation being done through an osteoplastic opening.

It is really therefore, with few exceptions, only the endotheliomata which are accessible, accurately diagnosed beforehand, and approached through an osteoplastic opening, that are capable of the ideal radical treatment which I premised. In my own experience these constitute only 12 per cent out of a total of 336 operations for cerebral tumour. For one reason or another, such as wrong diagnosis, post-operative fatalities, and operation at too late a stage, the actual percentage of such results attained was only 5.

1. CEREBRAL GLIOMATA.

Let us now see what results may be expected in the case of the gliomata of the cerebral hemispheres. In the majority of these cases nothing was done beyond a simple decompression; in a few, cysts were emptied, or partial removal of a solid tumour was effected. In some, radium was buried in the growth for twenty-four hours. A few were submitted to X-ray treatment.

Frontal Gliomata.—42 cases (6 cystic):—

- 17 died shortly after operation
- 4 were discharged from hospital and not traced
- 10 survived for an average period of 8 months
- 8 were living upwards of 2 years after operation
- 3 made remarkable recoveries.

Occipital Gliomata.—12 cases (1 cystic):—

- 3 died shortly after operation
- 1 was discharged but not traced
- 6 survived for an average period of 4 months
- 1 lived for 3 years
- 1 was alive and well, but hemiparetic, 11 years after operation.

Post-central Gliomata.—31 cases (5 cystic):—

- 4 died shortly after operation
- 3 were discharged but not traced
- 18 survived for an average period of 8 months
- 6 were alive and well, though with various degrees of disability, after an average interval of 22 months.

Temporal Gliomata.—25 cases (3 cystic):—

- 3 died shortly after operation
- 4 were discharged but not traced
- 12 survived for an average period of 10 months
- 6 were alive and well, some with disability of various degrees, after an average period of $4\frac{1}{2}$ years.

The results of operations upon the gliomata are summarized in *Table I*.

Table I.—RESULTS OF OPERATIONS ON CEREBRAL GLIOMATA.

	NUMBER OF CASES	POST- OPERATIVE DEATHS	NOT TRACED	GOOD RECOVERIES	AVERAGE SURVIVAL OF REMAINDER
					Months
Frontal ..	42	18	4	8	8
Occipital ..	12	3	1	2	4
Post-central ..	32	4	3	6	8
Temporal ..	26	3	5	7	10
Total ..	112	28	13	23	7-8

For the sake of comparison I may mention that during the same period the following malignant tumours other than gliomata were met with—namely, 14 sarcomata and 2 secondary carcinomata. Of the sarcomata, 6 were frontal, 2 occipital, 5 post-central, and 1 was temporal; of the carcinomata, 1 was post-central and 1 frontal. There were also 2 cases of cholesteatoma and 1 of hydatid cyst.

2. CEREBELLAR TUMOURS.

In the present series there have been 57 operations for cerebellar tumour (excluding cerebellopontine tumours, which are considered separately). Of the 38 in which the nature of the tumour was verified, 25 were gliomata, 4 sarcomata, 2 secondary carcinomata, and 7 tuberculomata. In the remaining 19 cases either no tumour was found, or its nature was not ascertained. The post-operative deaths were 11 in number (19.2 per cent). In the 25 verified cases of glioma no fewer than 10 were gliomatous cysts, a remarkably high proportion when compared with the gliomata of the cerebrum (40 per cent as against 13.5 per cent). Seven patients are alive and well at an average period of 3 years after the operation, whilst the average survival period of the remainder was 13 months. Comparing these figures with those of the cases in which a simple decompression was done for unverified tumour, we find that 7 are alive and well at an average period of $2\frac{1}{2}$ years after the operation, whilst the average survival period of the remainder was 8 months.

To sum up briefly what my own experience has led me to expect as the result of operative measures in the case of the cerebral gliomata, I would say that about 25 per cent of the patients die shortly after operation; about 50 per cent die within eight months; and about 25 per cent make good recoveries, some able, for several years at any rate, to live useful lives and to earn their living. When we reflect that these patients are suffering from a tumour which, left alone, will inevitably prove fatal, often after a period of blindness and intense suffering, we may feel that such results, meagre as they may be, are not to be despised. They are at least as satisfactory as those obtained in the treatment of cancer of the oesophagus or rectum. It should be pointed out, too, that in the series quoted there has been no picking and choosing of cases. With very few exceptions of persons actually *in extremis*, every patient has been given such chance of relief as operation seemed to afford, so that many cases are included which, had the exact extent and nature of the

tumour been known beforehand, might not have been submitted to operation. Further, there can be no doubt that some of the bad results in the earlier cases, of twenty years ago and more, were due to errors of judgement and faulty technique.

When we turn to the cerebellar gliomata, we find that although these tumours are so situated that they can more easily cause rapid and severe increase of intracranial tension, as compared with the majority of supratentorial tumours, and in a region where the operative risks and difficulties would naturally be expected to be greater than in the case of supratentorial, yet on the whole the outlook is definitely more favourable. This can be accounted for in several ways. First, the exact localization of a cerebellar tumour is usually easier than that of many of the supratentorial gliomata; secondly, the tumours in this situation are more liable to undergo degenerative changes, as indicated by the very high proportion of cysts, which are three times as common in cerebellar as in cerebral gliomata; and, thirdly, in the remarkable capacity which exists for compensation of cerebellar function. As compared with gliomata of the cerebrum, the operative mortality is less than half, the proportion of good recoveries is higher, and the average survival period of the remainder is nearly twice as long.

3. ENDOTHELIOMATA.

The results of operation on endotheliomata of the cerebral membranes are set out in *Tables II* and *III*.

Table II.—TUMOUR COMPLETELY REMOVED.

		NUMBER OF CASES	POST- OPERATIVE DEATHS	GOOD RECOVERIES	AVERAGE SURVIVAL OF REMAINDER
					Months
Frontal	..	18	5	12	18
Occipital	..	2	0	1	3
Post-central	..	10	2	6	8
Temporal	..	1	0	0	12
Total	..	31	7	19	10

Table III.—DECOMPRESSION ONLY.

		NUMBER OF CASES	POST- OPERATIVE DEATHS	GOOD RECOVERIES	AVERAGE SURVIVAL OF REMAINDER
					Months
Frontal	..	4	1	0	8
Occipital	..	0	0	0	0
Post-central	..	5	1	3	12
Temporal	..	1	0	0	2
Total	..	10	2	3	7

It will be seen therefore, that of 41 cases of endothelioma, the tumour could be, and was, completely removed in 31, and that of these, 19

made a good recovery and were alive and well at the time of writing (46 per cent).

The operative mortality compares very unfavourably with that which occurred in the case of the gliomata; but I would emphasize the fact that I have included all my earliest cases of some years ago, when the technique of these operations was crude and ill-developed, when localization was less accurate, and when enucleations were carried out in the presence of a greatly raised intracranial pressure.

These tumours, innocent in nature, and susceptible of early and accurate diagnosis, are the most favourable of all the intracranial tumours for radical treatment. Yet, in spite of every favourable circumstance, unlooked for and undeserved fatalities sometimes occur. One of the most promising cases which I ever saw, after an entirely uneventful recovery from the operation, developed, on the third day, an uncontrollable succession of Jacksonian fits, so that the patient died of exhaustion. Others, of apparently far less favourable aspect, have made complete and uneventful recoveries.

4. CEREBELLOPONTINE TUMOURS.

During the period under review I have operated upon 47 cases of tumour situated in the cerebellopontine angle. The nature of 40 of these tumours was ascertained, and was as follows: 36 neurofibromata (4 completely cystic), 2 cholesteatomata, 1 sarcoma, and 1 fibroglioma. In 9 the tumour was completely enucleated, with but a single recovery, the patient being in perfect health four years later.

In 11 cases only a decompressive operation was done, the tumour being untouched, or only a fragment of it being removed for examination. Amongst these there were 4 post-operative deaths, the average survival period of the remainder being five years.

In 27 cases the tumour was removed as completely as possible from within its capsule, the mass being broken up and removed piecemeal by suction. Of these patients, 4 died shortly after the operation, whilst of the 25 survivors, 2 died a year later, 2 were alive and well upwards of four years, 2 three years and upwards, and the rest two years and under.

5. TUMOURS AND CYSTS INVOLVING THE PITUITARY REGION.

I have operated upon 68 cases of supposed pituitary tumour, in all of which the determining factor was the hope of saving or improving vision. In the case of the pituitary adenomata, with conspicuous symptoms of glandular disturbance and characteristic X-ray appearances, the diagnosis is easily made, but in many other cases the exact state of affairs can only be ascertained by exploratory operation. I have therefore divided my cases, for the purposes of the present report, into two classes:—

1. *Pituitary tumours proper*, mostly adenomata, arising in the sella turcica and invading the cranial cavity. Of these there have been 33 cases with 9 deaths (the majority naturally amongst the earlier operations of the series): 4 trans-sphenoidal operations with 1 death, 1 temporal operation with no

death, 28 trans-frontal operations with 8 deaths. In my last 15 cases there have been only 3 deaths.

2. *Suprapituitary tumours*, arising above or in close relation with the sella, including infundibular, interpeduncular, and frontal lobe tumours, and cysts of various kinds. Amongst these there have been 6 temporal operations with one death, and 29 trans-frontal operations with 3 deaths.

Whilst it is a simple matter to indicate statistically the results of this or any other operation as regards immediate mortality, it is not easy to set out in any such straightforward manner the far more important results which concern the condition of those who emerge successfully from such operations. This is not the place to go into the details of individual cases, and one must be content to give one's impressions of the results in their broadest aspects. Judged first from the point of view of visual disturbance, the outstanding symptom for which, at present, pituitary operations are generally performed, the gain has in practice proved to be such as greatly to outweigh the operative risks, and it is quite certain that, when these cases are submitted to operation at an earlier period, before the power of recovery of the visual paths has been seriously impaired, the results as regards vision will be still more gratifying. It is for the ophthalmic surgeon more than anyone else to make himself acquainted with the progress and possibilities of pituitary surgery, for it is chiefly to him that these patients entrust themselves for advice and treatment. Judged from the point of view of comfort, the relief of pressure afforded by these operations results in freedom from headache and often an improved mentality. The patients become brighter, more alert, and better able to carry on with their occupations. It is too early to say anything as to the effects from a standpoint of endocrine function. In a few instances there have been rapid and definite alterations in the metabolic and other disturbances, but how far these may be but transitory is not at present known. They are, however, such as to suggest that, with the increasing safety of the operation, it may come within the scope of legitimate surgery to operate for the arrest of acromegaly in its early stages.

TWO HUNDRED CASES OF CANCER OF THE RECTUM TREATED BY PERINEAL EXCISION.

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HISTORICAL.

THE operation for the removal of rectal cancer has undergone very considerable changes during the last twenty-five years, and we may roughly divide these changes into four periods. During the first period surgeons removed the growth by splitting up the rectum and dissecting out the growth, working from inside the rectum, or at least with one finger in the bowel. The operative field was necessarily soiled, and inevitably became septic. Convalescence from such an operation was long and tedious, six months being not an uncommon time; the results as regards continence were poor, and generally there was recurrence within a few months, although not always. This was the type of operation Herbert Allingham performed at the time when I used to assist him.

The second period was that of Kraske's operation, where an incision was made over the rectum from behind, and part of the sacrum removed. The section of the rectum containing the growth was cut out, and the two ends of the bowel were sewn together again, as well as could be managed, or a sacral anus was established.

Both these methods were only applicable to a few selected cases, and the results were almost invariably bad. Serious sepsis was inevitable after these operations, and the successful cases as regards recurrence were usually those where the subsequent sepsis removed extensions of the growth which the operation failed to do. The mortality was high, and the functional results as a rule were very poor. Many of the patients had a permanently incontinent sacral anus, and often a bad prolapse developed which caused a great deal of trouble. The recurrence figures after Kraske's operation were very unsatisfactory, and the great majority of those patients surviving the operation died of early recurrence. They did not all have recurrence, as I know of several who are alive to the present day.

The abdomino-perineal operation which marks the next period was the first great advance in the surgery of rectal cancer, and was a decided improvement on anything that had gone before. It fulfilled two important factors which had hitherto been lacking—a free removal of the growth and surrounding tissues, and a technique which made it *possible* to eliminate sepsis. At first the operation was designed so as to allow the end of the colon to be brought down to the anus and more or less normal function to be restored; but it was soon found that this added serious dangers to an operation which was already very risky. It is not possible to ensure an adequate blood-supply to the transplanted colon, and this method has now been almost universally abandoned in favour of terminating the operation with a permanent colostomy.

While the operation is a great improvement upon its predecessors, it has certain serious drawbacks as a routine method of removing rectal cancer. The mortality of the operation, even in the hands of experienced operators, is very high—in any large series of cases it is 30 per cent or over, and it cannot be performed on people over 60 years of age, or where there are complicating conditions—in fact, the mortality can only be kept down to at all a reasonable level by a very careful selection of cases. This is a serious drawback, since the majority of cases of rectal cancer occur at ages between 55 and 65, as will be seen by reference to the age tables; and, moreover, many of the patients have some complicating disease. A mortality of anything near 30 per cent cannot be faced with equanimity, and it was in order to get a technique that would allow of satisfactory removal of the growth, and at the same time get rid of the high mortality, that I adopted the perineal operation I now perform as a routine method, and reserved the abdomino-perineal operation for cases otherwise inoperable. The abdomino-perineal operation, or some modification of it, remains the method of choice for growths too high up to allow of removal by the perineal route; but I think that the perineal operation should become the method of choice for all cases of true rectal cancer.

It is obvious that the correctness or otherwise of my contention depends upon the results as regards both the mortality and, more especially, the recurrence rate after the perineal operation; and this paper, which is a description of the whole of the results of 200 consecutive cases, is published with a view to proving the correctness of this statement.

A few months ago I completed my 200th case of perineal resection of the rectum for cancer, and as the cases both in private and in hospital have been as carefully traced as is possible. I think the publication of the results will be of value in showing what the actual results are in a large series of cases, and what may be expected by this operation. Cases where the growth was situated at or above the recto-sigmoidal junction are not included in this series, as they have been dealt with by the abdomino-perineal operation. I would particularly stress this point, as there is a distinct temptation to attempt removal of very high growths by the perineal route owing to the greater ease and safety of this operation. Attempts, however, at removal of a very high growth in the rectum by the perineal route involve the operator in serious difficulties, and discredit the operation, which was never intended to deal with such cases.

The following cases are a complete sequence of 200, of which 100 were operated on in private and 100 in hospital. The period covered by the series is a long one, and includes the development of the technique now employed. Considerable improvement has naturally taken place in the details of the operation and subsequent treatment, so that the results in many ways are better in the later cases. The recurrence figures are worked out only on the earlier cases, as it is only in cases operated upon before or during the first few months of 1921 that a sufficient time has elapsed to judge of the curative results of the operation. In regard to these figures it must be borne in mind that the comparative safety of the operation has resulted in many advanced cases being operated on which would not have been considered justifiable if a more serious procedure was involved; and that for the same reason a large

number of quite old persons have been operated upon, no fewer than 72 patients being over 60 years of age, and these could not have been operated on at all had the abdomino-perineal route been used.

Age.—The following are the ages in the 200 consecutive cases operated on :

Under 30	30-40	40-45	45-50	50-55	55-60	60-65	65-70	Over 70
3	10	10	22	36	47	42	16	14

It will be seen that the age at which the largest number of cases occurred is between 55 and 60, the next commonest the following five years, but that after reaching a maximum at 55 to 65 there is a rapid decline in the number of cases as the age increases. There can be little doubt that this decline is

due to the decreased number of persons living over the age of 60, and partly to the fact that at the higher ages a larger number of cases are inoperable on account of their age. The chart (*Fig. 59*) is given to show the age incidence of cancer when taken from a really large number of cases. It is from Dr. Frederick Hoffman's "Mortality of Cancer throughout the World", and shows, as might be expected, a steadily increasing incidence of cancer with increasing age.

My age table demonstrates the value of an operation with a comparatively low mortality risk, as it will be seen that no fewer than 72 patients out of 200 would have been too old for operation by the abdo-

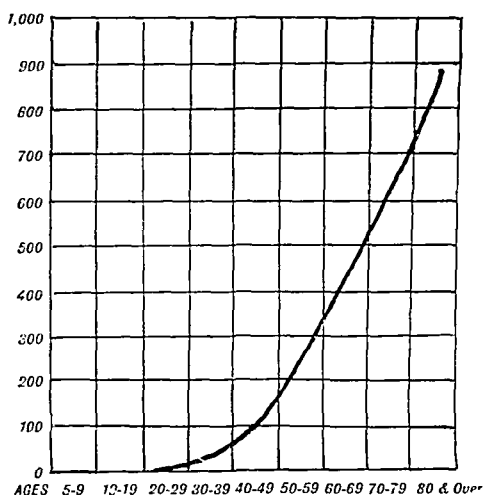


FIG. 59.—Cancer mortality. Age rate per 100,000 population.

mino-perineal route. As a matter of fact, of the patients over 70, only 2 died as the result of the operation.

Sex.—Of the 200 cases, 123 were males and 77 females. This is in the proportion of 3 males to 2 females, and corresponds very closely to the proportion shown in the Ministry of Health figures for 1925, which work out at 4 males to 3 females.

PREDISPOSING CONDITIONS.

In this series of cases, what would appear to be the most important predisposing cause of the disease, apart from age, is the presence of simple adenomata in the bowel. For the last two years these have been very carefully looked for in all cases of excision, with the result that they were found associated with cancer in all but a very few of the cases examined. It seems probable that in the few cases in which no adenomata were discovered they may have been present higher up in the bowel, since the area examined was necessarily confined to the parts removed (*Fig. 60*). This is borne out by the fact that in one case an adenoma was found on the mucous membrane of the

colostomy. This subject has been extensively dealt with by Dr. Dukes, the pathologist at St. Mark's Hospital, in a paper read before the Proctological Section of the Royal Society of Medicine on Jan. 13, 1926.

In one case (*Fig. 61*) there were two distinct carcinomata in the rectum within half an inch of each other. Sections cut for histological examination from the intermediate submucous tissue fail to show any signs of continuity between the two growths. In this case the presumption is that both growths had arisen simultaneously in simple adenomata previously present.

Four cases (Nos. 1, 3, 18, 137) are remarkable in that another primary cancer developed in the same patient after an interval of years. One patient had his rectum removed for cancer, and eighteen years later returned with another small growth in the colon some 8 in. higher up. This also was successfully resected, and he is still alive, now twenty-one years since the original operation. Another patient developed a growth 11 in. higher up in the colon six years after a growth in the rectum had been removed by perineal resection. In neither case was there any evidence that the second growth was a recurrence of the first one. It had all the characteristics of a primary growth, and there were no glands involved nor any signs of secondary deposits. Another patient developed a duct carcinoma of the left breast three years after the removal of the rectum for cancer. The fourth patient also developed a duct carcinoma of the breast two years after the removal of the rectum for adenocarcinoma. This last patient died from recurrence of the breast tumour without showing any signs of secondary growths from the rectal tumour. In addition, there is the patient already mentioned who had two growths present at the same time.

Both clinical and experimental evidence seem to prove that one malignant tumour inhibits the development of another primary growth in the same individual. The cases just quoted would seem to show that the inhibitory action does not always last very long—indeed, it is questionable whether the incidence of cancer in these cases, as shown by four having developed a second growth, is much less than the normal incidence would be for patients of this age who had not had a growth before: but the figures are too few to draw any definite conclusions.



FIG. 60.—Cancer of rectum removed by perineal excision, showing associated adenomata.

rather more of the pelvic peritoneum can be removed by the abdominal route; but it is very doubtful if in any case recurrence can be avoided once these secondary glands have become involved. The few more inches of pelvic colon that are resected by the abdominal route probably make no difference as regards recurrence, since it is now known that spread along the bowel itself is very unusual beyond the immediate limits of the growth. *Fig. 64* shows the parts actually removed.

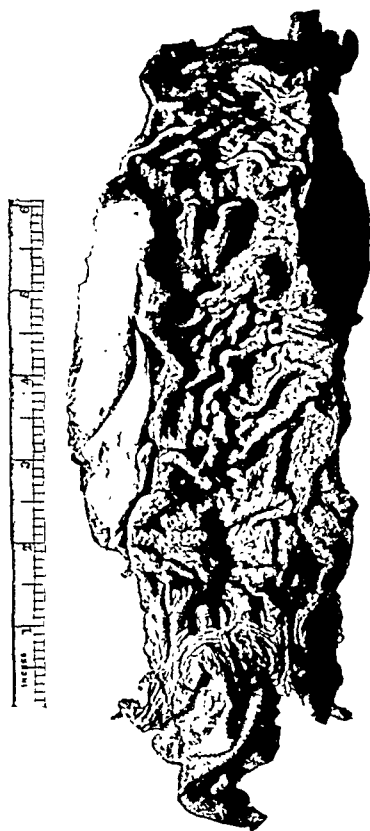


FIG. 63.—Specimen removed by perineal excision, showing the amount of tissue.

THE OPERATION.

A detailed account of the operation will not be given here, as it has already been described several times, and the object of this paper is to analyse the results rather than to discuss the operative technique.

The operation is done in two stages, a permanent colostomy being performed either a week beforehand or at the time of the resection. Either spinal or regional anaesthesia is used, aided by gas and oxygen or twilight sleep.

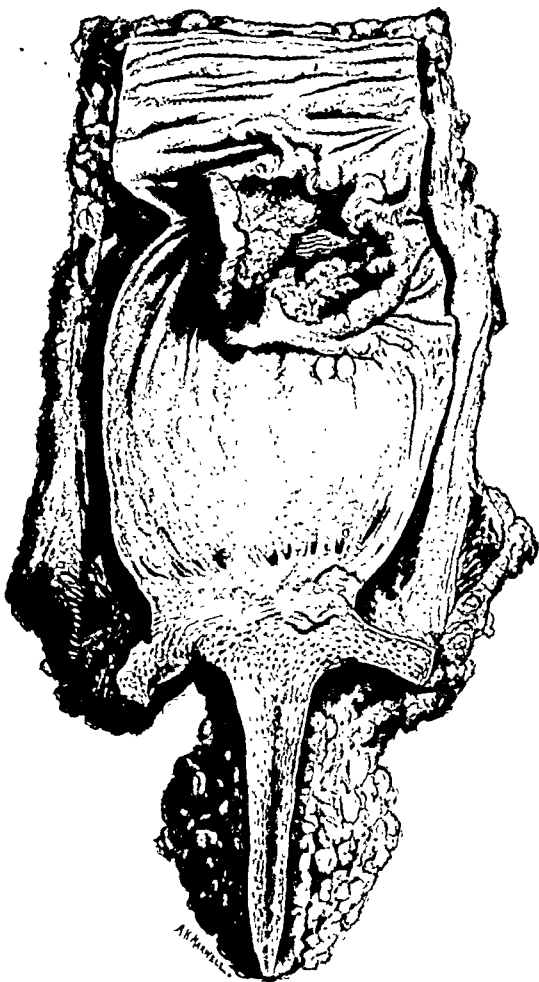


FIG. 64.—Drawing of actual specimen to show the tissues removed by perineal resection. Note the entire rectum and surrounding tissues, including levatores muscles and anal skin. ($\times \frac{1}{2}$.)

The patient is placed in the semi-prone position, head down, and if a male a catheter is tied into the bladder. The anus is first closed with a purse-string suture passed subcutaneously with a curved needle, and an incision is made from the base of the sacrum, passing around the anus and about 1 in. from it. The coccyx is removed by dissection, and the deep fascia divided transversely just in front of the sacrum. Both levatores ani muscles are divided close to the pelvic wall with scissors, and the rectum is then dissected off the vagina in the female, or from the urethra and prostate in the male, until the peritoneum is reached. The peritoneum is opened, and as much bowel drawn down as possible. The mesorectum is clamped off as far back as can be managed, and divided. The clamps are tied off, and, after dividing the peritoneal coat of the pelvic colon and stripping it back for a short distance, the bowel is crushed and divided with a cautery. The stump is ligatured and turned in with a purse-string suture, and the wound in the peritoneum closed with catgut stitches. The wound itself is closed without drainage in most cases. In a few a small rubber wick is inserted. The wound is not dressed for forty-eight hours, and then the blades of a pair of dressing forceps are introduced between two of the stitches, and any accumulated fluid allowed to escape. If the wound remains quite clean, it is allowed to heal by first intention; but if the accumulation of serum continues, a stitch is removed, a small piece of drainage tube is introduced, and the cavity kept irrigated with weak Dakin or Milton solution. The patient is allowed out of bed on the fourteenth day, and is generally able to return home in from three weeks to a month.

Operative Mortality.—In the 100 private cases there were 3 deaths, a mortality of only 3 per cent, while in the 100 hospital cases there were 14 deaths, a mortality of 14 per cent. The very marked difference between the mortality in private and hospital cases is due to several factors. The private cases are, of course, better nursed, as they all have special nurses who have no one else to attend to, while in the hospital the staff is more or less chronically overworked, and the same individual attention cannot be given. Probably a more important factor is that the ordinary hospital patient is not in such good general condition. Hospital patients tend to come up for treatment in a more advanced state of the disease, they are not so well nourished, and are relatively older at the same age as the result of hard work. At any rate they do not seem to have the same recuperative powers as the wealthier classes. It is no doubt a combination of these factors which accounts for the difference. It is now my practice to keep the hospital patients in bed for at least a week, and often longer, before operating, in order to improve their chances, and this seems to have considerably improved the mortality risk.

I think it is fair to claim that a 3 per cent operative risk is as good as can be hoped for in any operation for the removal of the rectum; more particularly as the cases have been in no sense picked ones, any cases where there seemed to be a fair possibility of safe removal having been submitted to operation, irrespective of age and associated disease. Thus no fewer than 72 patients were over 60 years of age, and 14 were over 70. As regards associated disease, 2 cases had Graves' disease, 1 had Hodgkin's disease, 3 had diabetes, 3 had diverticulitis, 1 woman of 48 had an aortic aneurysm, 1 man had hæmophilia.



FIG. 61.—Specimen of rectum removed by operation, showing two separate primary growths. Probably arising simultaneously in previously existing simple adenomata, several of which can be seen in the lower part of the specimen. Microscopical sections cut from the submucous layer between the tumours showed no carcinoma cells.

In several cases there was direct evidence that the cancerous growth had developed in a simple adenoma which had been present for a number of years previously. I consider an adenoma of the rectum as a definite precancerous condition, to be dealt with as such.

A specimen of one very remarkable case is shown in *Fig. 62*. This growth was the earliest stage of cancer of the rectum that I have ever seen. The actual growth was a little over $\frac{1}{2}$ in. in diameter, and a section of the entire growth is shown in the figure in section magnified eight times. Histological examination of this growth shows a very strong probability that it started as a simple adenoma.

TISSUES REMOVED BY THE PERINEAL OPERATION.

These consist of the entire rectum and a few inches of the pelvic colon, together with, in one piece, the skin surrounding the anus for an inch or more, the levatores ani muscles together with the pelvic fascia reflected on to them, most of the fat in the ischiorectal space and upper pelvic space between these muscles and the rectum, and the greater part of the mesorectum and all the glands lying in immediate relationship with the bowel. These are the tissues normally removed; but when rendered necessary or advisable from the nature of the case, the posterior part of the prostate gland and vesiculae seminales can be removed, and in the female the whole of the posterior vaginal wall, and even the uterus.

The actual difference between the amount of tissue removed by this operation (*Fig. 63*) and by the abdomino-perineal route is very slight. A few more of the secondary glands in the base of attachment in the mesorectum and



FIG. 62.—A complete cancer of the rectum enlarged eight times. The original specimen was about 1 cm. in diameter, and projected like a little button in the rectal wall.

Causes of Death.—Of the three deaths which occurred in the private cases, two were from heart failure and one from chronic sepsis. Their respective ages were 63, 75, and 54.

The deaths from the hospital cases were as follows: sepsis, 6; pulmonary embolism, 1; hæmorrhage (one case of hæmophilia), 2; shock, 1; pyelonephritis, 1; dilatation of the stomach, 1; pneumonia, 2.

I do not think that it is possible to keep the mortality figures for the hospital cases as low as in the private cases, though considerable improvement is no doubt possible. Even at the present time nearly 80 per cent of all the patients coming up to the hospital for treatment are quite inoperable when first seen, and it is the very late stage at which these patients submit themselves for treatment, rather than anything else, which diminishes their chances, as against the private cases, who are seen earlier.

RECURRENCE FIGURES.

I think I have been able to show that the operation risk is as low as can be hoped for from any operation for resection of the rectum; and the value of the method, therefore, depends upon its ability to cure the patient from the disease, as evidenced from the recurrence rate. It is usual to work out recurrence rates on a three-years basis; but I have always considered that this is much too short a period, as unoperated cases often live as long as this. A five-years basis is much better, though this, too, is not really long enough. The difficulty, however, of working out figures for any period longer than five years is so great that I do not think one can take anything beyond a five-years basis. The following figures have been worked out on the basis of patients surviving the operation a clear five years. There were 95 cases operated on over five years ago. These work out as follows:—

	CASES
Cures on 5-years basis	45
Recurrences	37
Died from other causes during the 5 years ..	6
Untraced cases	7
Total ..	95

If we subtract the untraced cases and those that died of other causes, i.e., 14 cases, it gives us 82 cases with 45 cures, or a percentage of cures on a five-years basis of 54·8. If, instead of subtracting the untraced cases and 'died from other causes' cases, we divide these into their probable recurrence rate, which would be roughly 50 per cent, and add 7 cases to the cures, this would make 95 cases with 51 cures, or a percentage of 53·6 cures.

Taking a three-years basis instead of a five-years, there are 125 cases, with 73 cures and 42 recurrences, which gives 55·5 per cent cures. The chances, therefore, of a patient being alive five years after the operation are over 50 per cent.

If we now examine these figures in a little more detail we find several interesting points. All the cases were originally divided into three classes, marked in the table—A, B, and C.

A: very favourable cases where the growth was small and had not apparently invaded the muscular coat, and no glands were involved.

B: medium cases where there was involvement of the muscular coat, but where the growth was not unduly fixed and there was no extensive involvement of glands.

C: very bad cases, where the growth was large and fixed, or where there was evidence of extensive involvement of glands. These were borderline cases with a bad prognosis.

Out of a total of 200 cases there were: 73 A cases, 96 B cases, 31 C cases. An analysis of these three classes as regards recurrence is very interesting. Taking only the cases which were operated on over five years ago, and leaving out untraced cases and deaths from other causes, we find that the result is as follows:—

CASES	TOTAL	CURES, 5-YEARS BASIS	RECURRENCES	PERCENTAGE CURE
A cases	30	22	8	73·7
B „	43	19	24	44·1
C „	9	4	5	44·4

N.B.—The untraced and those who died of other causes have been subtracted from the totals.

This shows that with picked favourable cases the percentage of cures on a five-years basis is very high. The pity is that more cases are not operated on at this stage. The figures for the C cases are doubtless misleading, as they are too few; but they show one very important point, namely, that such cases are well worth operating upon. These C cases all showed such extensive growth that recurrence seemed probable, and yet there were four cases which survived the five-year period, one even surviving 18 years. The argument deduced from this is that growths differ very much as regards their liability to recurrence after removal. There is at present no means of estimating this liability in any individual case, nor do we know the reasons for it. A certain number of apparently hopeless cases never get a recurrence, while some of the most hopeful ones do. It is this fact which is the strongest argument against extensive block resections as a routine treatment for carcinoma. While we should always remove the growth as freely as possible, compatible with reasonable safety, the facts do not seem to justify very extensive removal when this entails serious additional risk.

Thirty-nine of the cases have been traced beyond the five-years period, and the following table shows what happened to them:—

TABLE OF 39 CASES TRACED BEYOND 5 YEARS, SHOWING THE NUMBER OF YEARS THAT HAVE ELAPSED SINCE OPERATION.

CASES	YEARS	CASES	YEARS
1 ..	21	3 ..	9
2 ..	14	7 ..	8
2 ..	11	8 ..	7
3 ..	10	13 ..	6

N.B.—Out of these 39 who lived beyond the 5 years, 5 died between the 5th and 7th years from recurrence, but there are no known recurrences in any patients surviving beyond this period.

DISABILITY PRODUCED BY OPERATION.

When dealing with so serious and fatal a disease as cancer, disability after operation is a relatively unimportant factor. It becomes important, however, when comparing one method of treatment with another.

The disability which results from the perineal operation is entirely due to the presence of a permanent colostomy opening in place of the normal anus. This is, of course, also true of the abdomino-perineal operation. This disability is not a serious one—in fact, not nearly so serious as might well be imagined. Patients are able to live comfortable and useful lives, and after the first few months it is remarkable how little inconvenience the colostomy causes.

The best way, perhaps, to estimate the disability is in reference to the wage-earning capacity of hospital patients. We find that this is not diminished except in the case of very heavy labour involving strenuous exertion. The vast majority of patients were found to be still in the same employment as formerly. Thus, out of 20 cases apparently cured by operation, 6 were women, 5 of whom did their housework, and 1 was a stationer's assistant. There were 14 men, of whom 10 were in full work in the following occupations: printer's cutter, fish-curer, schoolmaster, packer, tailor, pilot, messenger, waiter, platelayer, and odd-job man. Three were living in retirement, being over 65 years of age; and one, who used to be a farm labourer, no longer works.

CONCLUSIONS.

These figures show that when the operation is performed under the most favourable conditions the mortality is only 3 per cent, and that the percentage of cures on a five-years basis is 50 per cent; while where specially favourable, picked cases alone are dealt with, the proportion of cures on a five-years basis reaches the very high figure of 73 per cent. This compares most favourably with cancer of the breast or any other organ.

It is only by the collection of a large number of cases and publication of the results that we can arrive at any satisfactory judgement of the merits of any operation. That no statistics of this character are entirely satisfactory must be admitted, for they do not show the whole truth. The proper way in which such statistics should be worked out is to take, say, 500 consecutive cases of cancer presenting themselves for treatment, and show the number of cases operated upon, the operative mortality, and the percentage of cures, based on the original 500 cases. Such tables, if they could be worked out (as a matter of fact they cannot, as a large number of inoperable cases do not reach the surgeon at all), would form a useful guide as to the relative merits of different operative procedures. Unfortunately, they would show such a relatively low percentage of cures out of the total that they would be depressing reading.

It is to earlier diagnosis that we must look for any material improvement in our cancer cures from operation.

TABLE SHOWING RESULTS AND SUBSEQUENT HISTORY
OF THE 200 CASES.

A = Very favourable. B = Medium cases. C = Border-line cases. D = Death from operation.
R = Recovery from operation.

PRIVATE CASES.

CASE	YEAR OF OPERATION	SEX AND AGE	TYPE OF CASE AND RESULT	LENGTH OF SURVIVAL AND REMARKS
1	1905	M. 37	C. R.	21 years: in 1923 a new growth occurred in upper part of rectum; the second growth was excised
2	1912	M. 60	A. R.	14 years
3	1913	F. 68	A. R.	8 years: 4 years after had duct cancer of breast, which was removed; died in 1921 of apoplexy
4	1915	M. 60	B. R.	7 years: died of heart disease in 1922
5	"	M. 62	C. R.	5 years: died of cerebral disease
6	1916	M. 52	A. R.	2 years: died of recurrence
7	"	F. 75	A. R.	6 months: died of pleurisy
8	"	M. 63	C. R.	2 years: recurrence in liver
9	"	M. 52	B. R.	9 months: died of recurrence
10	"	M. 43	A. R.	9 years
11	1917	M. 66	B. R.	9 years
12	"	M. 67	B. R.	2 years: died of pneumonia
13	"	M. 52	B. R.	2 years: recurrence
14	"	F. 63	B. R.	2½ years: recurrence in pelvis
15	"	M. 68	B. R.	6 months: probably recurrence
16	"	M. 68	A. R.	Alive 5 years, untraced later
17	"	M. 57	A. R.	8 years
18	"	M. 53	A. R.	7 years: died of a second primary growth in colon which recurred after removal
19	"	M. 57	A. R.	8 years
20	1918	M. 55	B. R.	8 years
21	"	F. 40	C. R.	6 years: recurrence in vagina
22	"	F. 62	A. R.	2 years: recurrence
23	"	F. 58	B. R.	Alive 3 years later, but had recurrence
24	"	M. 50	B. R.	Alive 4 years later, but had recurrence
25	"	F. 50	B. R.	Alive 3 years, but recurrence in colon
26	"	F. 36	B. R.	1 year later, recurrence in vagina
27	"	F. 70	B. R.	1 year: died from coma; no local recurrence
28	"	F. 56	A. R.	7 years (had Graves' disease for 20 years)
29	1919	F. 44	B. R.	2 years: recurrence in lumbar glands
30	"	M. 56	B. R.	7 years
31	"	M. 72	B. R.	6½ years
32	"	M. 51	B. R.	6½ years: died of recurrence
33	"	M. 64	B. R.	6 years (had Hodgkin's disease at time of operation)
34	"	M. 54	B. R.	6 years
35	1920	F. 54	C. R.	4 years: died of recurrence
36	"	F. 52	B. R.	6 years
37	"	F. 42	A. R.	1 year: recurrence
38	"	F. 60	B. R.	6 years
39	"	F. 43	A. R.	6 years
40	"	M. 51	C. R.	1 year: recurrence in lumbar spine
41	"	F. 63	B. R.	4 years: recurrence in liver
42	1921	M. 72	A. R.	5 years
43	"	M. 61	B. R.	5 years
44	"	F. 54	B. R.	2 years: recurrence
45	"	M. 61	A. R.	5 years
46	"	M. 52	A. R.	4 years
47	"	F. 53	C. R.	4 years
48	"	M. 62	A. R.	2 years: recurrence
49	"	M. 69	A. R.	4 years: died of 'seizure': no recurrence

[Continued on next page]

RESULTS AND SUBSEQUENT HISTORY—*continued.*

CASE	YEAR OF OPERATION	SEX AND AGE	TYPE OF CASE AND RESULT	LENGTH OF SURVIVAL AND REMARKS
50	1921	M. 60	A. R.	4 years: died of recurrence
51	"	F. 58	A. R.	3 years: died of recurrence (had Graves' disease)
52	1922	M. 51	C. R.	Few months later local recurrence, died after X-ray burn
53	"	M. 47	B. R.	3 years: alive in 4th year but has recurrence
54	"	F. 46	A. R.	4 years
55	"	F. 39	C. R.	2 years: recurrence
56	"	M. 63	C. D.	Sepsis
57	"	M. 38	A. R.	3 years: died 4th year, recurrence in liver
58	"	M. 46	A. R.	4 years
59	"	F. 47	B. R.	3 years: recurrence
60	"	F. 75	C. D.	'Heart failure' 3 weeks after operation
61	"	M. 56	B. R.	3 years
62	1923	M. 45	B. R.	2 years: recurrence
63	"	M. 64	A. R.	3 years
64	"	F. 54	B. D.	'Heart failure'
65	"	M. 64	A. R.	3 years
66	"	F. 63	A. R.	3 years
67	"	M. 59	A. R.	Died 1 year later of recurrence (had diabetes and diverticulitis)
68	"	F. 60	A. R.	3 years
69	"	F. 70	B. R.	3 years: diabetes
70	"	F. 68	C. R.	1 year: recurrence
71	"	F. 63	B. R.	3 years
72	"	M. 69	B. R.	1 year: recurrence in liver
73	"	F. 60	A. R.	Alive to date
74	"	F. 50	A. R.	" "
75	"	M. 56	A. R.	" "
76	"	M. 72	B. R.	" "
77	"	F. 58	B. R.	" "
78	1924	M. 73	B. R.	" "
79	"	M. 62	B. R.	" "
80	"	M. 65	B. R.	" "
81	"	F. 59	B. R.	" "
82	"	F. 71	B. R.	" "
83	"	M. 64	B. R.	" "
84	"	M. 59	B. R.	" "
85	"	M. 64	B. R.	" "
86	"	M. 67	B. R.	" "
87	"	F. 61	A. R.	" "
88	"	F. 56	A. R.	" "
89	"	M. 56	A. R.	" "
90	1925	F. 62	A. R.	" "
91	"	F. 58	B. R.	" "
92	"	M. 55	A. R.	" "
93	"	F. 58	A. R.	" "
94	"	F. 52	A. R.	" "
95	"	M. 73	A. R.	" "
96	"	F. 75	B. R.	" "
97	"	M. 65	C. R.	" "
98	"	F. 71	C. R.	" "
99	"	F. 58	C. R.	" "
100	"	M. 72	A. R.	" "

HOSPITAL CASES.

101	1910	M. 56	B. R.	Untraced
102	1911	M. 59	A. R.	14 years
103	1912	M. 61	C. R.	1 year: recurrence

PERINEAL EXCISION IN CANCER OF RECTUM 123

RESULTS AND SUBSEQUENT HISTORY—*continued.*

CASE	YEAR OF OPERATION	SEX AND AGE	TYPE OF CASE AND RESULT	LENGTH OF SURVIVAL AND REMARKS
104	1913	F. 59	B. R.	Died of recurrence
105	"	M. 58	B. R.	Untraced
106	"	M. 62	A. R.	"
107	1914	M. 53	B. R.	6 years: recurrence
108	1915	M. 49	B. R.	11 years
109	"	M. 61	B. R.	1 year: died of tuberculosis
110	"	M. 50	B. R.	11 years
111	"	F. 43	B. R.	2½ years: recurrence
112	"	F. 45	B. D.	Shock
113	1916	F. 62	A. R.	10 years
114	"	M. 68	B. D.	Sepsis
115	"	M. 35	C. D.	Hæmorrhage (hæmophilic)
116	"	M. 54	B. R.	1 year: recurrence
117	"	M. 46	B. R.	2 years: recurrence in liver
118	"	F. 53	A. R.	10 years
119	"	M. 52	B. R.	10 years
120	"	M. 48	B. R.	1 year: recurrence
121	"	M. 48	A. R.	9 years
122	1917	M. 64	B. D.	Sepsis 4 weeks after operation
123	"	F. 34	A. R.	Alive 5 years later, but had recurrence
124	"	F. 62	C. D.	Sepsis
125	"	M. 35	A. R.	3 years: untraced later
126	"	M. 58	A. R.	8 years
127	"	M. 59	A. R.	8 years
128	"	M. 50	A. R.	Untraced
129	"	F. 43	A. R.	3 years: recurrence
130	1918	M. 45	B. R.	6 years: recurrence in liver
131	"	M. 57	B. R.	2 years: died of recurrence
132	"	F. 48	B. R.	8 years
133	"	M. 47	B. R.	Died of recurrence in 3rd year
134	"	M. 47	A. R.	2 years: died of cerebral hæmorrhage: no recurrence
135	"	M. 60	A. R.	7 years
136	"	M. 54	A. R.	3 years: recurrence in liver
137	"	F. 48	C. R.	5 years: died of cancer of breast
138	"	F. 57	C. R.	1 year: recurrence
139	"	M. 50	A. R.	2 years: recurrence
140	"	M. 62	A. R.	Untraced since 1920
141	"	M. 57	A. R.	7 years
142	1919	M. 66	A. R.	7 years
143	"	M. 50	A. R.	1 year: recurrence
144	"	F. 26	A. R.	Untraced
145	"	F. 60	B. R.	Recurrence 2 years later in vagina, died 4 years later
146	"	M. 46	A. R.	7 years
147	"	M. 29	A. R.	1 year: recurrence
148	"	F. 56	B. R.	9 months: recurrence
149	"	F. 59	B. R.	18 months: recurrence
150	"	M. 54	B. R.	2 years: recurrence
151	"	F. 63	C. D.	Ascending pyelonephritis after cystitis
152	"	F. 48	B. D.	Sepsis
153	1920	M. 66	B. R.	6 years
154	"	F. 61	B. R.	1 year: recurrence (had diverticulitis)
155	"	M. 52	C. R.	6 years
156	"	M. 59	B. R.	6 years
157	"	M. 63	B. R.	1½ years: recurrence
158	1921	M. 57	B. D.	Sepsis
159	"	F. 43	B. R.	2 years: recurrence in liver
160	"	M. 55	B. D.	Sepsis
161	"	F. 59	B. R.	4 years

Continued on next page

RESULTS AND SUBSEQUENT HISTORY—*continued.*

CASE	YEAR OF OPERATION	SEX AND AGE	TYPE OF CASE AND RESULT	LENGTH OF SURVIVAL AND REMARKS
162	1921	F. 53	B. R.	2 years : recurrence in liver
163	"	M. 28	C. R.	2 years : recurrence
164	1922	M. 56	B. R.	3 years, untraced later
165	"	M. 58	B. D.	Bronchopneumonia
166	"	F. 48	C. R.	4 years (had aortic aneurysm)
167	"	M. 59	B. D.	Pulmonary embolism
168	"	F. 53	B. R.	4 years
169	"	F. 38	B. R.	4 years
170	"	F. 64	C. R.	2 years : recurrence in groin (had diverticulitis)
171	"	M. 66	A. R.	3 years
172	"	M. 54	B. R.	1½ years : recurrence in liver
173	"	F. 72	C. D.	Pneumonia
174	"	F. 74	B. R.	1 year : recurrence in liver
175	"	F. 66	B. R.	3 years
176	"	F. 59	B. R.	3 years
177	"	F. 56	B. R.	3 years
178	"	M. 60	A. R.	Alive to date
179	"	M. 61	A. R.	" "
180	"	M. 53	C. R.	" "
181	"	F. 66	B. R.	Had diverticulitis : alive to date
182	"	M. 65	A. R.	Alive to date
183	1924	F. 56	B. R.	" "
184	"	F. 53	A. R.	" "
185	"	M. 63	B. R.	" "
186	"	F. 60	C. D.	Hæmorrhage
187	"	M. 40	C. R.	Alive to date
188	1925	F. 65	B. R.	" "
189	"	M. 51	A. R.	" "
190	"	M. 63	B. R.	" "
191	"	M. 64	B. R.	" "
192	"	M. 58	A. R.	" "
193	"	M. 55	B. R.	" "
194	"	M. 73	C. D.	Dilatation of stomach
195	"	M. 60	A. R.	Alive to date
196	"	M. 62	A. R.	" "
197	"	M. 51	C. R.	" "
198	"	M. 51	A. R.	" "
199	1926	M. 63	A. R.	" "
200	"	M. 63	B. R.	" "

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THE ETIOLOGY OF CONGENITAL INGUINAL HERNIA AND ABNORMALLY PLACED TESTES.

BY RICHARD H. HUNTER, BELFAST.

It is said by Keith¹ that the transition of the testis from the abdomen to the scrotum is brought about by the atrophy and contraction of the gubernaculum ; but if this strand of tissue is to pull on the testis it must have a fixed point from which to act, and such a point is absent in the human fœtus. The testis of a newly-born infant with the processus vaginalis and its fascial coverings can be lifted out of the scrotum without tearing anything but a little superficial connective tissue, the gubernaculum being attached to the deep aspect of the fascial coverings of the testis, which separate it from the skin of the scrotum (*Fig. 65*).

At an early stage in development the genital gland of each side is united to the deep aspect of the anterior abdominal wall by a fold of peritoneum termed the inguinal fold (*Fig. 66*). A condensation of mesenchyme—the anlage of the gubernaculum—occurs between the layers of this fold, passing from the lower pole of the genital gland, mesonephros, and Wolffian duct, through the abdominal wall, to end in an indefinite manner in the neighbourhood of the genital tubercle. This cord of tissue is present in the 13-mm. human embryo, i.e., at a stage before the abdominal musculature is differentiated. When the latter begins to form it must grow around the cord, and the inguinal canal must therefore contain the gubernaculum from the beginning.

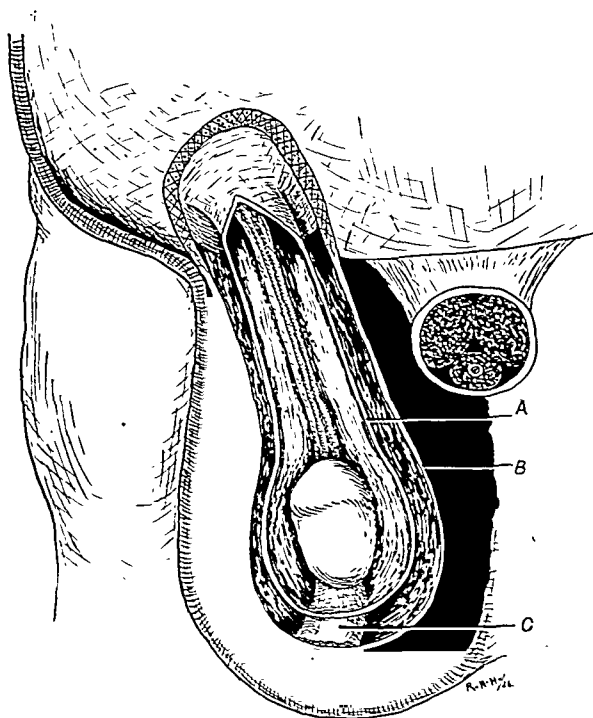


FIG. 65.—Dissection of the scrotal region of a newly born infant, showing the arrangement of the fascial coverings. Note the position of the gubernaculum, which is not attached to the skin of the scrotum. A, Processus vaginalis, cut edge; B, Fascial coverings, cut edge; C, Gubernaculum.

About the middle of the 12th week the gubernaculum grows rapidly, and the part immediately below the testis becomes bulbous, and spreads out in a fan-shaped manner into six separate strands. One of these strands ends near the saphenous opening, one passes upwards towards Poupart's ligament, one passes towards the pubis, one to the root of the penis, one to the perineum, and one towards the scrotum. These strands are unequal in size, and normally in the human subject the largest strand passes to the scrotum.

The gubernaculum reaches its greatest development about the middle of the 6th month, and then gradually becomes smaller and less easily defined, until at birth all the fibres have disappeared except the large strand passing to the scrotum.

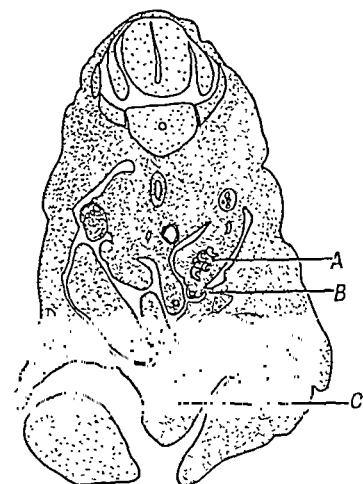


FIG. 66.—Transverse section of human embryo of 20-mm. crown-rump length, showing the position of the inguinal fold. A, Mesonephros; B, Inguinal fold; C, Genital tubercle.

At the 20-mm. stage in the human embryo (Fig. 67) round growing cells are to be seen streaming outwards from the neighbourhood of the genital gland, along the largest strand of the elongated gubernacular cells, towards the genital tubercle—the scrotal area—and, with the appearance of these cells, the processus vaginalis begins

to form as an outpocketing of peritoneum, following in the same direction.

The processus vaginalis increases in length until the beginning of the 7th month, when growth apparently ceases. The apex of the cone-shaped processus at this time reaches the level of the junction of the scrotum and the anterior abdominal wall, and the large growing cells begin to disappear.

During this time changes have been occurring in the position of the testis itself. At the early 5th month, when the growth of the gubernaculum is at its height, the upper pole of the testis is on a level with the lower border of the first sacral vertebra. At the beginning of the 7th month, after atrophy of the gubernaculum has begun, the testis rises to the level of the upper border of that vertebra; but in the 8th month it again passes downwards to the level it occupied at the 5th month, with its lower pole lying within the opening of the processus vaginalis—another proof that the testis is not drawn down by the atrophy of the gubernaculum.

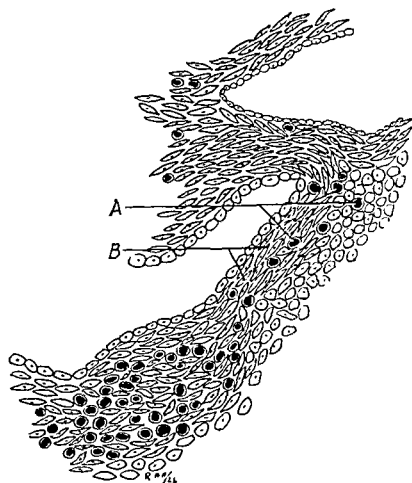


FIG. 67.—Drawing made with the camera lucida to show the position of the large growing cells (A) wandering out along the strand of elongated gubernacular cells (B), in the inguinal fold of a 20-mm. human embryo.

About the 6th month of foetal life the large intestine is a simple tube ; but soon the gut enlarges, becomes distended with meconium, and relatively larger than the same gut in the adult. As development proceeds, the gut enlarges still further, and *pari passu* the intra-abdominal pressure increases until the middle of the 8th month, when it would appear to be raised to such a point that the testis is forced out of the abdomen into the processus vaginalis, through the inguinal canal to the scrotum.

This view, that the testis is forced from the abdominal cavity into the scrotum by the intra-abdominal pressure, is in complete agreement with that of Bland-Sutton,² who many years ago described the phenomenon as an evolutionary or developmental herniation which occurs after the formation of a complete diaphragm when high degrees of intra-abdominal pressure are produced with the evolution of an active life involving running and jumping. Such methods of progression generate strains and stresses³ within the animal's own body, the changes of intra-abdominal pressure being brought about by the fore-limbs and hind-limbs being in opposite phases of motion. The two halves of the elongated trunk are upheaved when their respective limbs are brought into contact with the earth, and depressed in the interval of time between successive contacts.

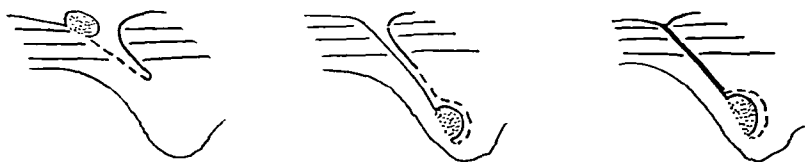


FIG. 68.—Diagram illustrating the changes in the processus vaginalis during the descent of the testis.

The peritoneum adheres intimately to the proper fibrous tunic of the gland, so that when the testis passes from the abdomen to the scrotum it carries the loosely folded peritoneum of the iliac fossa with it (*Fig. 68*). Just before this occurs, the apex of the processus vaginalis reaches the point where the scrotum and the anterior abdominal wall meet ; but after the testis descends, it reaches the most dependent part of the scrotum. This apparent increase in length of the processus is due to the drawing down of the iliac peritoneum, a movement that can be demonstrated on a fresh foetus which has not been treated with any preservative or hardening reagent, if an opening is made in the abdominal wall, the testis grasped with a pair of forceps, and a pull made towards the scrotum.

Then, again, if the peritoneal cavity of a fresh unhardened foetus be injected with a thin solution of gelatine, the effect on the testis of raising the intra-abdominal pressure can be directly observed.

In the younger stages, before the full formation of the processus vaginalis, at the period when the gubernaculum is still growing and invaginating its deep layer and partially occluding its lumen, the testis does not pass into the scrotum, but acts like a plug at the abdominal opening of the processus vaginalis (*Fig. 69*). From the middle of the 7th month, however, when active growth of the processus ceases and the gubernaculum begins to atrophy,

the testis passes from the abdominal position through the inguinal canal to the scrotum.

It has been suggested that, as the intra-abdominal pressure is a fluid one, it cannot have a selective action on the testis, and cause it alone to move.⁴ This would be a sound criticism were it not for the fact that each testis is lying in a gutter of peritoneum, just at the entrance of the inguinal canal; and although the pressure within the abdomen is a fluid pressure, acting in all directions with the same force, it causes the testis to move, because each testis lies at the preformed internal opening of the inguinal canal.

In discussing the development of the gubernaculum and the processus vaginalis, it was seen that the latter follows the direction of the former. In the human foetus the largest bundle of the gubernaculum normally passes to the scrotum; but if any of the other bands should be the largest, then the processus will pass in a corresponding direction, and in turn the testis will take up an abnormal position—in the perineum, root of penis, symphysis pubis, fossa ovalis, or over Poupart's ligament.

A study of comparative anatomy would appear to prove this statement, for in marsupials the largest bundle of the gubernaculum passes to the pre-penile position, and normally the testis is found in that position in the adult. In the pig the largest bundle of the gubernaculum may be traced to the perineum, and the testis of that animal is normally found there.

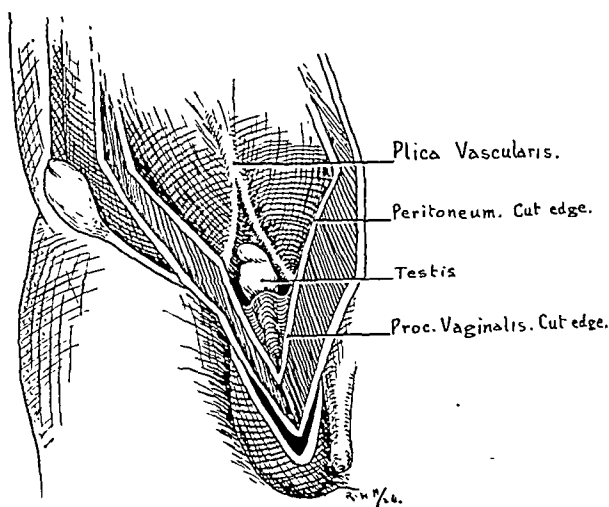


FIG. 69.—Dissection of 7th-month human foetus showing position of testis in the gutter-like opening of the processus vaginalis, just before descent.

These are the conditions found when the processus vaginalis is developed to its usual size; but if development is arrested before this has occurred, the testis will be unable to reach its usual position, and only a partial descent of the testis results. Every surgeon knows the shortness of the peritoneal processus in such cases when he attempts to bring the testis down to its normal place in the scrotum. This condition, however, must not be confused with the relatively common form of partial descent where the testis lies just at the external abdominal ring and is found at operation to be held in that position by a sac of peritoneum, folded either upwards, outwards, and towards the anterior superior iliac spine over the abdominal wall, or upwards and medially towards the pubic region, a condition due to the large growing cells wandering away from any of the recognized routes, and carrying the sac over Poupart's ligament, folding it over the latter, and preventing the testis passing beyond the external ring.

When the testis gains its scrotal position the processus vaginalis communicates with the general peritoneal cavity, but in the human subject the cavity of the processus normally becomes obliterated between the internal abdominal opening and the upper pole of the testis. This part is known as the funicular portion of the processus, and, when the obliteration is complete, a congenital hernial sac does not exist; but when the obliteration of this part does not occur, a hernial sac of what I shall call *Type a* (Fig. 70) results. If partial obliteration only occurs, there is formed the partial funicular hernial sac shown in *Type b*.

The apex of the processus vaginalis normally reaches to the point of junction between scrotum and anterior abdominal wall; but when the testis passes to the scrotum, it carries with it just sufficient iliac peritoneum to reach its fundus. If, however, growth has been excessive, and the processus has reached a point beyond the normal, then there is more peritoneum present

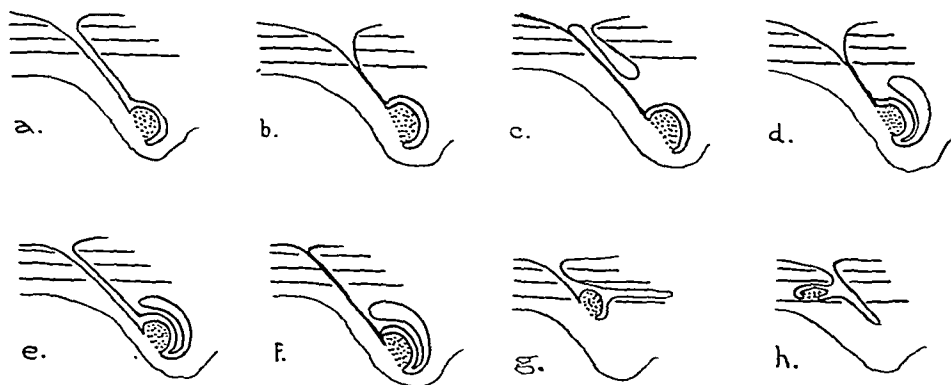


FIG. 70.—Diagram illustrating various types of hernial sacs.

than is necessary for this space, and the extra peritoneum becomes folded upon itself. This may occur in one of two ways:—

1. If there is only a small excess of peritoneum, *Type c* will result, with or without obliteration of the funicular portion. This is the commonest form of hernial sac found in children.

2. If a large excess of peritoneum is present, the surgeon finds *Type e* at operation. The funicular portion in this case may become completely occluded except for the folded portion over the testis, and a potential hydrocele of *Type f* results; or, again, it may become partially occluded, and a hydrocele with a partial funicular hernial sac of *Type d* results.

Some of the large growing nucleated cells may wander between the muscles of the abdominal wall and produce secondary pockets of peritoneum, or interstitial hernial sacs, as shown in *Type g*. The sac of this form of hernia may lie between any two muscles of the abdominal wall, or between the transversalis muscle and the subperitoneal fat, or between the external oblique and subcutaneous fascia. These hernias are usually associated with some interference with the complete descent of the testis to the scrotum, and

may appear as such a variation as that shown in *Type h*, where the testis is placed interstitially, and the apex of the hernial sac just beyond the level of the external abdominal ring. ✓

CONCLUSIONS.

1. The testis, processus vaginalis, gubernaculum, and fascial coverings can be lifted out of the scrotum of a newly-born infant without tearing anything but a little superficial connective tissue.

2. The gubernaculum therefore is not attached to the skin of the scrotum, and the testis cannot be drawn from the abdominal cavity to the scrotum by its contraction.

3. The gubernaculum at first acts as a kind of anchor to the testis; its largest strand normally passes to the scrotal region in the human foetus and forms the path for the large growing cells which cause the growth of the processus vaginalis.

4. The processus vaginalis develops as a cone-shaped diverticulum of peritoneum, and, just before the descent of the testis, its apex normally reaches to the point of junction between the anterior abdominal wall and the scrotum.

5. During the descent of the testis the peritoneum, which is adherent to the proper fibrous tunic of the gland, is drawn down into the scrotum.

6. If the processus vaginalis is longer than normal before the testis descends, the excess of peritoneum present will become folded upon itself and form a hernial sac.

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THE TREATMENT OF CANCER OF THE ŒSOPHAGUS.

By A. LAWRENCE ABEL, LONDON.

(Being a Hunterian Lecture delivered before the Royal College of Surgeons of England on February 10, 1926.)

IN the following paper it is my purpose to prove that cancer of the œsophagus can and should be diagnosed at an early date after its commencement; that it is a relatively benign, mild type of malignant growth; that radium, X rays, and diathermy are of very little value in the treatment of the disease. Our attempts at surgical treatment of cancer of the œsophagus have been influenced by our great reliance upon the peritoneum in abdominal surgery; but the œsophagus, like the pharynx, is a very special region in surgery because of septic infection and the absence of any covering analogous to peritoneum. It is my purpose to prove that the operations planned and suggested and put forward are feasible, and that on the face of them there is no physical or pathological reason why they should not be followed by success. And, lastly, drawing analogy from other operations which have only been in use for a few years, all that remains is to add the little fine points of technique by which a perfect operation with a high percentage of cures is obtained.

DIAGNOSIS.

Cancer of the œsophagus is a common disease, one case in every twenty of malignant growth being situated in the gullet. It occurs most commonly in men in the prime of life between the ages of 55 and 60, but it has been known to occur in a child of 14 years and in patients over 90. For every six or seven men affected the disease appears in only one woman.

Symptomatology.—The symptoms of a developed case—namely, dysphagia, discomfort in the chest relative to swallowing, and vomiting, or, more accurately, regurgitation of food—are well known, and instead of describing these I wish especially to emphasize the early or insidious symptoms of the disease. It is unfortunately uncommon to see a case of carcinoma of the œsophagus in its earlier stages, and in fact the average duration of symptoms before a case comes to the surgeon is from six to eight months. This is for two reasons: firstly, because the patient does not pay attention to the earlier symptoms; and secondly, because the majority of the medical public do not recognize the significance of these symptoms, or if they do recognize them, do not know that life may be saved, or at any rate prolonged, by prompt surgical interference.

The first symptom is not always dysphagia, and usually the patient notices for some weeks or months that there is a sense of oppression or weight beneath the sternum. It is important to emphasize that actual pain is conspicuous by its absence, and the sense of discomfort is due to the slight dilatation of the œsophagus from the early narrowing of its lumen, together with

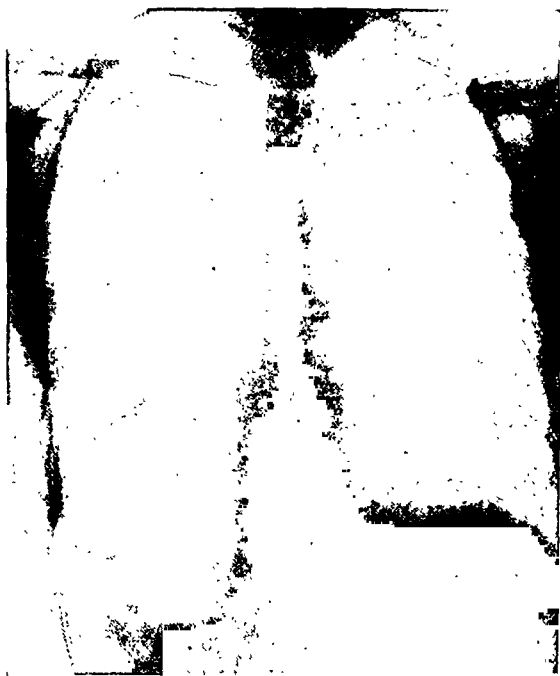


FIG. 71.—Cancer of the œsophagus. The radiogram was taken in the anteroposterior plane and shows the poor definition of the œsophagus on account of the opacity of the mediastinum.



FIG. 72.—Cancer of the œsophagus. The picture shows the clear outline of the shadow made by the opaque drink when the radiogram is taken obliquely through the thorax.

colicky sensations of oppression due to increased muscular contractions of the organ. These sensations are usually noticed when swallowing is attempted, but may be present independently of deglutition. Then the patient finds that, in order to overcome the sense of fullness while eating, he has to take considerable draughts of fluid with his meals in order to wash the food into the stomach. At last there is a distinct obstruction to the passage of food.

In nature the dysphagia is essentially progressive, at first being noticed with solids, later with semi-solids, and lastly with liquids.

Physical Examination.—It has to be emphasized that a most careful general clinical examination must be undertaken. The presence of metastases, although aiding in the actual diagnosis of cancer, signifies at the same time that the case has progressed beyond the possibility of a radical cure.

The next step is the performance of a laryngoscopy in order to exclude any lesion of the pharynx or larynx. It is inadvisable to pass a bougie at this stage of the examination, and recourse should be had forthwith to radiography by means of the fluorescent screen, and the most satisfactory position is obliquely through the thorax. Having excluded any other abnormality of the thorax, a barium drink is given, and its passage down the gullet carefully observed with special attention to the presence, site, or degree of any delay or obstruction. These facts can be ascertained better by radioscopy than by radiography, and the patient may be rotated so that the most advantageous position is obtained. As soon as this is done and the required observations have been made, a previously prepared plate is adjusted into position, and a precise and permanent radiogram taken.



FIG. 73.—Radiogram of a case of cardiospasm, showing regular outline of œsophagus.

Even when no stenosis is present, X-ray examination is of value, as it may show a retention of a small portion of the opaque substance at the site of an early lesion, similar to the shadow sometimes left behind at the site of a gastric ulcer after the main gastric meal has passed on. This is most typically observed in a carcinomatous ulcer developing in a previously dilated œsophagus. If only a slight stenosis is present, no arrest of the fluid is seen, but a slight diminution in calibre of the tube may be indicated. This

frequently calls for a repetition of the examination, or at least indicates the region of the œsophagus to which special attention is to be paid on œsophagoscopy. Below the level of arrest the œsophagus is never well filled, as the substance passes rapidly into the stomach. Even if the exact nature of the cause of the obstruction is not typical enough to allow of a certain diagnosis, the site of the stenosis is located, and renders endoscopic examination easier.

I would indicate by means of radiographs the typical appearances of certain forms of œsophageal obstruction. In *Figs. 71 and 72* is seen the typical picture of barium passing through a malignant stricture, with the irregularity of its lower extremity (rat-tail-like appearance). *Fig. 73* shows the smooth regular outline seen in a case of cardiospasm. In a third case, the one picture (*Fig. 74*) shows a stricture with the barium appearing to pass from the lower



FIG. 74.—Radiogram of a case of hypopharyngeal diverticulum in the oblique position.

end of the dilated area; but when this patient was rotated and examined in the antero-posterior plane (*Fig. 75*), the barium could be seen emerging from the upper end of the dilatation, giving the typical radiosopic appearance of a Zenker's diverticulum.¹

If it is proposed to treat a case by means of radium, it is essential that the total length of the malignant stricture be accurately determined. For this purpose retrograde radiography is employed. This is done by placing the patient in a slight Trendelenburg position on an X-ray table, and the radiograph is taken while he is swallowing a fairly thick mixture from a drinking-cup. Or it may be sufficient to have the patient lying horizontally, with the right shoulder on the table and the negative placed against the posterior part of the left shoulder.



FIG. 75.—Radiogram of the same case taken in the anteroposterior position.

Lastly, the patient must be œsophagoscoped. This is of extreme importance, especially in the earlier stages of the disease, and should always be undertaken in order that an accurate diagnosis may be made. In skilled hands this procedure is almost devoid of danger. I was distressed a short time ago when a well-known French endoscopist said, "I understand that œsophagoscopy is never performed in England, as an English surgeon recently told me that he considered it an invariably fatal operation". I hastened to correct this, and am pleased to be able to say that no patient has died as a result of œsophagoscopy by my hands.

Space does not permit me to go into details of instrumentarium or technique; but I should like to recommend Bensaude's œsophagoscope², with the inner tube working on an ingenious ratchet which makes manipulation very easy. This I prefer for all examinations of the œsophagus, while, for local applications and intubations, I prefer the larger make of instrument by Souttar.³

Appearances on Œsophagoscopy.—As the examining tube approaches the level of a malignant lesion, the wall of the œsophagus appears relatively immobile and stiffened, and does not move, as it has been noticed to do at a higher level.

The actual appearance of the tumour varies with the type that is present. In the first or proliferative variety the growth has a cauliflower-like appearance (*Fig. 76*). The tumour is seen to be covered with a blood-stained fœtid discharge and bleeds very easily.

In the second or ulcerative type, the hard, raised, irregular, and everted edge is first seen; the ulcer appears somewhat raised, and the surrounding wall appears dense and indurated (*Fig. 77*). A light touch with a swab removes blood-stained fœtid material.

In the third or scirrhus type, the lumen of the œsophagus is seen to be greatly narrowed and deformed, whilst the mucosa appears retracted, red, smooth, and immobile (*Fig. 78*).

A portion of growth, when possible, must be removed for microscopical examination.

Early commencing carcinoma of the œsophagus is not often seen, and the presence of a slightly projecting immobile mucosa, with no obstruction to the passage of the tube, is easily overlooked and must be searched for most carefully. As the œsophagoscope is withdrawn, the observer should specially notice the manner in which the canal appears to close, as local rigidity and non-closure are characteristic of an early malignant lesion.

The examination should preferably be made with the use of a local anæsthetic, because the co-operation of the patient is of the greatest aid. The subjective sensations are not so disagreeable as might be expected, but with a nervous patient a general anæsthetic is used.

If the growth which has been diagnosed in the œsophagus is high enough to make extension to the trachea or bronchi possible, œsophagoscopy should always be supplemented by tracheobronchoscopy before any attempt at radical removal is undertaken, in order to be sure that the air-passages are not invaded by the growth.

Similarly with a growth at the lower end of the œsophagus, gastroscopy should be performed. I have recently had three cases in hospital at the same time, in each of whom an early growth was diagnosed at the lower end of the gullet. An ordinary opaque meal failed to show any abnormality of the

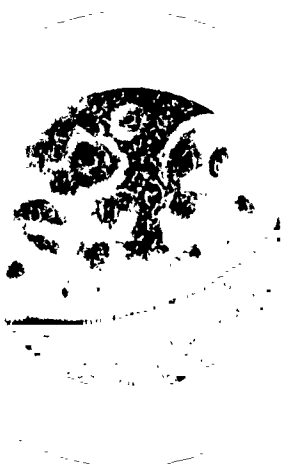


FIG. 76.—Endoscopic appearance of the proliferative type of carcinoma of the œsophagus.



FIG. 77.—Endoscopic appearance of ulcerative type of carcinoma of the œsophagus.



FIG. 78.—Endoscopic appearance of scirrhous type of carcinoma of the œsophagus with commencing proliferation.

stomach; but laparotomy with a view to attempting a radical cure revealed an extensive growth of the fundus which could have been diagnosed correctly had gastroscopy been performed.

PATHOLOGY.

Certain pathological factors must be borne in mind when any particular case is being considered, as every case of cancer should be considered, with a view to effecting a radical cure.

Primary carcinoma of the œsophagus may occur at any level, but is usually found at either extremity or in the narrowed portion where the œsophageal lumen is diminished by pressure of the left bronchus. The middle portion of the œsophagus is most commonly affected, the lower portion being next in order of frequency, and lastly the upper end, these being roughly in the proportions of 3 : 2 : 1.

The pathological types have already been shown in the pictures of the œsophagosopic appearances. The important matter from our point of view is the manner in which cancer of the œsophagus spreads. The two main routes are: (1) *By direct extension*; (2) *By the lymphatic stream*.

1. Direct Extension.—The growth at first, starting in the mucosa, spreads more or less concentrically, though, in the upper two-thirds of the organ, with a slight preference for the vertical direction. Infiltration then occurs into the submucous and muscle layers. *At a much later date* a stage of ulceration and of invasion of neighbouring organs is reached.

2. Lymphatic Spread.—There is but a slow tendency for œsophageal carcinoma to affect the lymphatics or to form metastases, compared with the rapidity with which the growth kills the patient. This usually prevents the lapse of sufficient time for spread by the lymphatic system to be markedly established.

At first the enlarged glands do not necessarily contain any carcinomatous cells, but may be purely inflammatory in nature, due to the infective processes taking place on the surface of a carcinomatous ulcer. Sooner or later, however, carcinomatous infection of the lymphatic glands is apt to occur, and an important point when the radical operability of carcinoma of the œsophagus is being considered is the time when the malignant invasion of the glands makes its appearance. In addition to the question, therefore, as to whether a carcinomatous growth has invaded neighbouring organs, or whether its local peri-œsophagitis has rendered it adherent in the mediastinum, are the questions: Are any local lymphatic glands involved? Are any more remote lymphatic glands involved? Has general metastasia taken place?

In order to answer these questions, in the absence of physical signs, the only method is that of recording and analysing a large number of post-mortem findings in patients who have died of the disease. From this a very fair estimate may be made; but it must be remembered, in dealing with the living subject, that his condition is not so far advanced as it will be on the day of his death, and therefore the outlook is brighter for the living than it would appear to be from examination of the dead.

Helsley,⁴ in his analysis of 70 cases carefully examined post mortem with regard to glandular involvement and metastases, found that in 64 per cent the carcinomatous condition was confined to the œsophagus, and no secondary deposits were present in the lymphatic glands or other organs. The local lymph nodes alone were involved in 6 per cent, whilst in the

remaining 30 per cent more distant lymph glands and other viscera were affected.

In a recent communication by Blauwkuip,⁵ he records the post-mortem findings with reference to this matter in 125 cases. Of these, in 39 per cent the disease was localized to the œsophagus, in 47 per cent no glandular involvement by the malignant process had taken place, while 64 per cent showed no metastases in remote organs.

The average duration of symptoms in Helsley's cases was almost five months, and it is therefore obvious that carcinoma of the œsophagus is at first, and for some considerable time, a purely local disease, and that there is ample time for the diagnosis and treatment of a case before metastases occur.

Even if extension to neighbouring organs, or perforation, has taken place, this may be seen when a radical operation is attempted, and judging from these figures, will be found to have occurred in not more than one case out of two. Even if this type of case has produced glandular metastases at the same rate as all classes of cases taken together, at least 50 per cent of these will not be accompanied by involvement of the lymphatic glands. Helsley goes so far as to state that "irrespective of the duration of the disease, the possibility of metastatic formation without evidence of the same should not be considered as a contra-indication to radical operation".

Most authors are in agreement that metastases do not tend to occur early, giving the freedom from metastases in from 46 per cent to 72 per cent of cases. It would thus appear from pathological findings at post-mortem that at least one case in four is operable to radical methods even up to the time of death. As many cases are seen several weeks or months before death, it would appear probable that at least one in three, or possibly one in two, of all cases seen should be curable by radical surgical operation.

PALLIATIVE TREATMENT.

With regard to palliative treatment, only the briefest outline will be given of the modern methods of treatment of cancer of the œsophagus in cases in which the presence of metastases indicates that an attempt at radical operation is futile, or in subjects so enfeebled that a major operation could not be borne.

Gastrostomy.—The majority of cases in this country are treated by gastrostomy alone so far as one is able to judge. This must be regarded as little short of masterly inactivity, and it is high time that we bestirred ourselves and expended much further effort to improve our technique with a view to active attack upon the disease of these unfortunate sufferers.

Dilatation.—A further step is repeated dilatations of the stricture. This must first be performed under endoscopic vision, and may then be followed every week or two by the blind passage of graduated sounds. Each treatment is followed by a general improvement in the patient's symptoms, and although not an ideal treatment and not devoid of risk, is to be recommended when more modern methods are not available.

Intubation.—This may be done with considerable benefit to the patient, and with more lasting effect than dilatation. I prefer the use of a gum-elastic tube such as Symonds's⁶ or a small de Pezzer's tube such as Guisez's.⁷ I have now used Souttar's tube⁸ in six patients. In three of these it passed into the stomach in a few days, and in the remaining three it formed an œsophago-tracheal fistula, with resulting death of the patient within a fortnight.

Radium.—The most active palliative method of treatment is by application of radium. The efficacy of this substance in the treatment of malignant disease has long proved a bone of contention between surgeons on the one hand and radiologists on the other; and an unbiased opinion of its true value is difficult to obtain. There seems little doubt that, in the treatment of malignant disease generally, radium causes a regression of the growth at the site of application, whilst sloughing is increased, hæmorrhage is brought on more quickly, and the periphery of the growth, or the infected glands at a distance, are stimulated to increased activity. The œsophagus, however, is unique in its position as an anatomical structure, and some of the contra-indications against radium may be waived; and, whilst it is not without a certain degree of danger, it frequently causes a great improvement in the patient's condition.

Radium is best applied through an œsophageal catheter. The upper limit of the growth having been carefully measured from the incisor teeth at the time of œsophagoscopy, and the length of the growth having been determined by retrograde radiography as already described, the catheter containing the radium is introduced so that the latter accurately fills the whole of the tumour-bearing area of the œsophagus (Guisez).⁹

The dosage recommended is 100 to 120 mgrm. of radium bromide, which should be applied on alternate days for some six to eight hours at a time, for a period of about two weeks. A remission of symptoms may now occur; but after a short time a cicatricial contraction supervenes, and this demands careful dilatation.

Guisez has 3 cases out of a total of 1430, of which 270 were treated by radium, which have survived for five years or more with this treatment.¹⁰ As far as is known, every other worker with radium shows a 100 per cent mortality.

Diathermy.—Judging from the results obtained in cases of malignant disease of the mouth and pharynx, diathermy should have an effect equal to, if not better than, the application of radium. I have had the opportunity of using this method of treatment in a few cases. Almost the whole of a projecting mass of growth can be caused to disappear, and the permeability of the œsophagus may sometimes be restored. Patients who are submitted to diathermy should show no signs of involvement of the lungs or air-passages either by the growth or by infective processes. Repeated small hæmorrhages point to an extensive ulceration, and may at any time be followed by a large, or even fatal, hæmorrhage, and are to be looked upon as a contra-indication. In suitably chosen cases diathermy is of marked value; but a fulminating mediastinitis or secondary hæmorrhage is apt to make its appearance with fatal results.

the œsophageal continuity; otherwise the patient will develop a stricture. It is usually advisable to attack the growth from the right side of the neck, in order that manipulation may not be hampered by the thoracic duct. The exact position of the growth having been ascertained previously, and an estimate having been gained of the breadth of the flap required to restore the continuity of the gullet, a flap is made with its base either at the right or left side of the neck and extending well beyond the mid-line. The next step, after hæmostasis has been secured, is to divide the deep fascia along the anterior border of the sternomastoid, and also to divide this muscle at its origin from the sternum and clavicle. The carotid sheath is now mobilized, after ligation of the inferior thyroid artery, and the prevertebral fascia and muscles discovered to its inner side. The anterior border

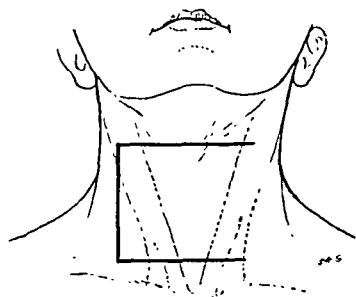


FIG. 79.—Diagram of position of skin-flap used in operations upon the cervical œsophagus.

of the sternomastoid is then sutured to the prevertebral region. The affected portion of the œsophagus is seen lying behind the trachea, with the prevertebral muscles and the sternomastoid behind and to the outer side. Very little blunt dissection is now required to separate the œsophagus from adjacent structures, and the region of the growth may be carefully examined and the possibility or otherwise of radical cure determined. If the case prove favourable, the trachea together with the thyroid gland and the recurrent laryngeal nerve are retracted, and the whole region surrounding the area of proposed excision is carefully packed off with sterilized gauze, which may with advantage be moistened with a solution of 1-500 perchloride of mercury. The next stage is to open the lumen of the œsophagus and thus expose the tumour to view. The surface of this must now be cauterized and carefully examined.

2. *Excision.*—With a small and early growth the incision around it must include three-quarters of an inch of apparently healthy œsophageal wall. In a larger growth this will mean the removal of a complete portion of the œsophagus with complete dissolution of its continuity.

3. *Reconstruction* (Fig. 80).—The flap of the skin is now turned inwards and made to lie in the position vacated by the piece of œsophagus removed. By means of mattress sutures the skin is then united to the mucous membrane, the epidermal surface forming the interior of this plastic portion of the œsophagus. The apex of the flap is now sutured to the portion of skin from which it was originally divided, thus leaving a depressed and funnel-shaped opening which passes into the

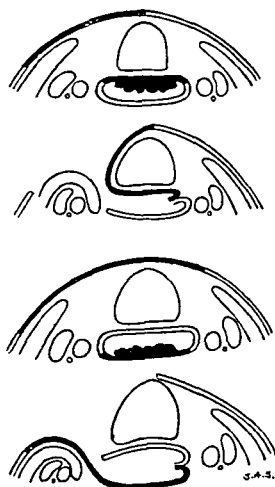


FIG. 80.—Diagram of formation of skin-flap in repair of cervical œsophagus after partial excision for carcinoma.

œsophagus. Through this opening a tube must be passed into the lumen of the œsophagus, and the patient must be attended constantly for at least one hour, but preferably longer, in order to make sure that the tube is neither vomited nor withdrawn by him. From the upper and lower edges of the field of operation pieces of gauze are left projecting, together with one or more drainage tubes; the function of the latter is to provide free egress for any leakage from the œsophagus, and therefore to diminish the possibility of the development of cellulitis; whilst the function of the former is to hasten the development of granulation tissue. After the first hour or two of consciousness after recovery from the anæsthetic the intra-œsophageal tube can easily be tolerated by the patient.

The Treatment of the Lymphatic Glands.—At the time that the original skin-flap is raised both sides of the neck come within the surgeon's reach, and the paratracheal, para-œsophageal, and inferior deep cervical glands are exposed, and may be removed. This must, of course, be done on both sides of the neck.

It is sometimes thought advisable to pass a tube from the lateral aspect of the neck not only downwards into the œsophagus but upwards into the pharynx. Some authorities, however, pass a tube through the mouth, the pharynx, and the newly-formed plastic part of the œsophagus into the œsophagus proper. Once the patient has recovered from the anæsthetic, this is usually well tolerated.

SURGICAL APPROACH TO THE THORACIC ŒSOPHAGUS (POSTERIOR MEDIASTINOTOMY).

We now pass to the treatment of those cancers of the œsophagus which are situated in the middle two-fourths of the gullet. In order to reach these, posterior mediastinotomy must be performed.

Preliminary Considerations.—A few words are necessary here with reference to thoracic surgery in general. The patient must be examined with a view to ascertaining that he is fit to stand a serious operation. If he is emaciated and the tissues are suffering from marked dehydration, a gastrostomy or jejunostomy must be performed from seven to fourteen days before the major operation.

Gastrostomy : Jejunostomy.—If the growth is known not to involve the stomach, gastrostomy is performed. If the stomach is likely to be involved in the major operation, jejunostomy must be performed. As the performance of such a fistula is frequently carried out in an unsatisfactory manner, I feel justified in describing what I have repeatedly found to be the method which gives uniformly satisfactory results. These remarks are applicable to either gastrostomy or jejunostomy.

It frequently happens that in a case in which gastrostomy is indicated a general anæsthetic is strongly contra-indicated, either because of definite evidence of lung disease, or of obstruction to the upper respiratory tract, or on account of the extremely wasted condition of the patient. Certainly under these circumstances, and even when no such condition is present, gastrostomy may be performed under the influence of a local anæsthetic.

This may be administered: (1) by local infiltration, (2) by regional nerve block.

A vertical incision is made along the line of the intradermal infiltration, and each layer divided in the same line. If the incision has been close enough to the costal margin the stomach will be found with no difficulty, though it is frequently very contracted and may lie almost entirely under cover of the costal margin. The stomach having been found, it is drawn into the wound, held in place by suitable forceps, and surrounded by damp cloths or a rubber-dam.

It now remains to make an opening into the stomach which will not allow

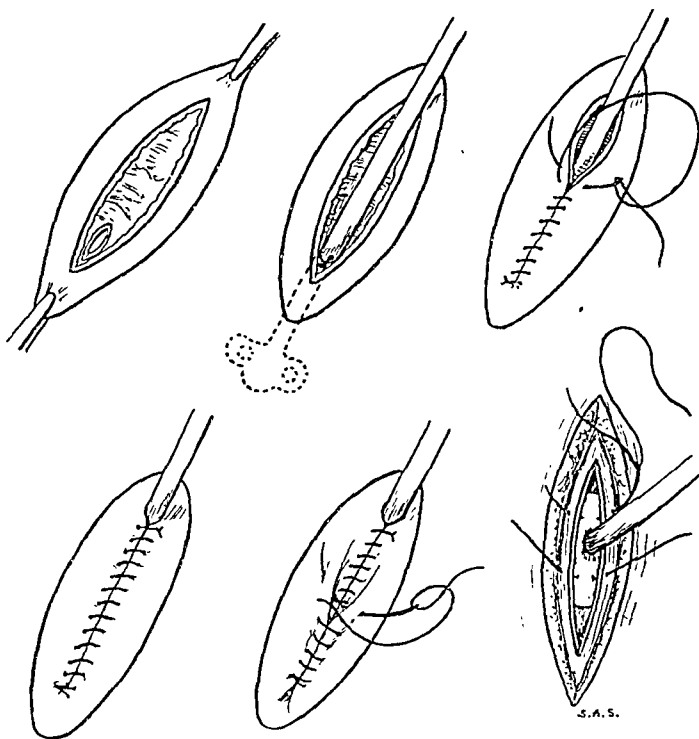


FIG. 81.—Diagram showing a modification of Witzel's gastrostomy.

an escape of gastric contents. This is best performed by passing the gastrostomy tube obliquely through the wall of the stomach. In order to attain this I use a modification of Witzel's method:¹⁴ an incision is made through the serous and muscular layers of the stomach in a longitudinal direction without injury to the submucous or mucous coats. A little blunt dissection separates these layers from the submucous layer on either side of the incision for a quarter of an inch. A stab incision is now made through the mucous membrane at the pyloric end of the incision and the gastrostomy tube passed into the stomach through this, and held in position by one or two catgut sutures. The tube is then laid along the prepared groove, and the serous and

muscular walls are sutured together in front of it by means of a continuous suture. Now, commencing half-an-inch beyond the pyloric end of the original incision into the stomach, a continuous Czerny-Lembert suture is employed still further to invaginate the tube and its seromuscular covering. The stomach is then sewn to the parietal peritoneum and the posterior sheath of the rectus by two or three sutures, and the abdomen closed layer by layer, leaving the tube projecting. I prefer the use of a large-sized self-retaining catheter or, better still, a large-sized de Pezzer tube. (*Fig. 81.*)

Blood-pressure.—Having successfully combated the patient's dehydrated state, the next point which requires attention is the condition of the blood-pressure. If this is less than 125 mm. Hg (systolic), treatment must be instituted until it reaches this pressure. The percentage of hæmoglobin should not be less than 60. If it is, a blood transfusion should be performed, using 500 c.c. of blood from a suitable donor forty-eight hours before the major operation. The coagulation time of the blood should be tested, and, if this is found to be less than seven minutes, an intramuscular injection of 30 to 40 c.c. of a sterile water solution of sodium citrate should be given at the commencement of the operation. The bowels should be moved forty-eight hours before, but no nearer to, the operation. Special attention must be paid to the sterilization of the skin, remembering that a small furuncle may infect a whole wound.

Lilienthal¹⁵ gives the following precautions when operating: (1) During the operation a blood-pressure apparatus should be kept adjusted and frequent readings taken. This will give warning of impending collapse before any other signs are evident. (2) Therefore plan the operation so that it can be stopped if the patient collapses, and continued at another sitting, the first stage having for its object the formation of adhesions, which diminish the complications due to the interference with the normal thoracic mechanism and thereby greatly reduce operative danger. (3) Make sure of the position of the growth, and that you are operating on the correct side. (4) Place the patient in the best position at the beginning of the operation.

Anæsthesia in Thoracic Surgery.—Major procedures within the thorax rank highest in that operative success depends upon the skill of the anæsthetist and the efficacy of the method of anæsthesia employed. I need not dwell long on this subject; it is sufficient to say that narcosis should be maintained by means of a nitrous-oxide-oxygen combination, using only a little ether at the time of induction until the intratracheal or endopharyngeal tube has been satisfactorily adjusted. By either intratracheal or intrapharyngeal insufflation a positive pressure may be maintained in the lungs, so that if the pleura is accidentally opened—as is often the case in exploration of the œsophagus—none of the ill-effects of an acute pneumothorax make their appearance.

The Pleura.—One must bear in mind that it is extremely easy to infect the pleura, and that therefore operations designed to effect partial or total œsophagectomy which do not entail opening the lumen of the gullet *in situ* are more apt to be successful than those where immediate section of the organ is performed.

Even with prolonged exposure alone a considerable quantity of serous

exudate is produced by the pleura during the first twenty-four to forty-eight hours after the operation. The lungs must therefore be fully inflated before the last stitch is tightened in order that adhesions may form rapidly, and if the time of the operation has been long a water-seal drainage should be used. *Fig. 82* shows the arrangement of this after Kenyon's method,¹⁶ together with a bottle to catch the discharge. The drainage tube must fit tightly into the thoracic wound, and must not project more than an inch into the pleural cavity.

Post-operative Shock.—As a greater or lesser degree of post-operative shock is bound to occur, I am a firm believer in taking steps to combat or prevent this before it makes its appearance. Already the patient has been rendered as fit as possible for the operation. When this is over, blood transfusion is perhaps our greatest aid, and may be performed even if it was done before the operation.

A simpler method, and one which I have used in a large number of major operation cases, including mediastinotomy, is to give an intravenous injection of 15 per cent glucose in either normal saline or sterile water together with 20 to 30 units of insulin intramuscularly. At the same time a subcutaneous injection of oxygen is given into the upper and outer aspect of the thigh, using from 500 to 1000 c.c. (McDonagh¹⁷).

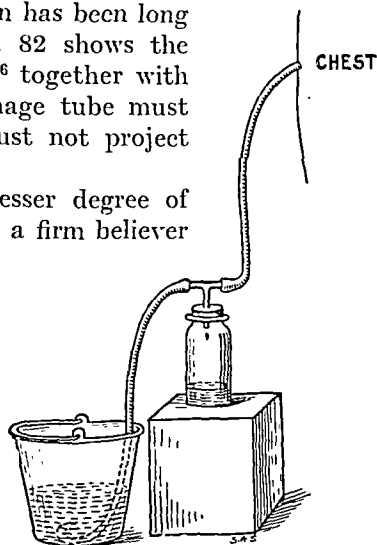


FIG. 82.—Kenyon's method of water-seal drainage.

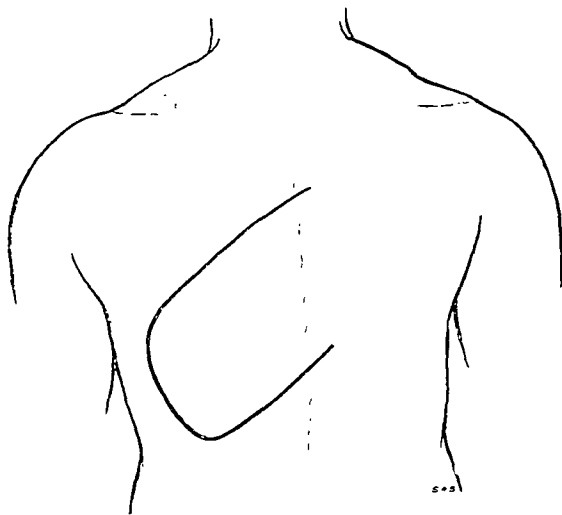


FIG. 83.—Diagram showing position of incision for skin-flap for reconstruction of thoracic oesophagus.

Hot rectal injections of saline with large proportions of glucose and bicarbonate of soda are of great value, as is also hypodermoclysis. Morphia has also a distinct place in this treatment.

Technique of Posterior Mediastinotomy.—When this operation is undertaken for the relief of cancer of the thoracic oesophagus situated above the lower two or three inches of the gullet, the incision must always be planned with a skin-flap of sufficient size to enable this to be passed around the tumour-bearing area of the organ.

If the growth is situated at or above the level of the aortic arch the incision is made in the right side of the back of the thorax. If below this

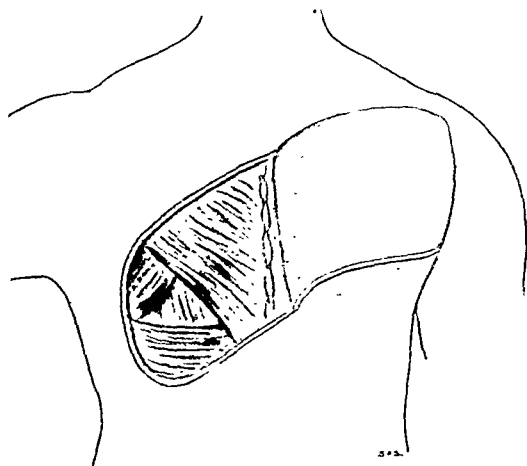


FIG. 84.—Diagram showing muscles exposed when skin-flap is dissected up.

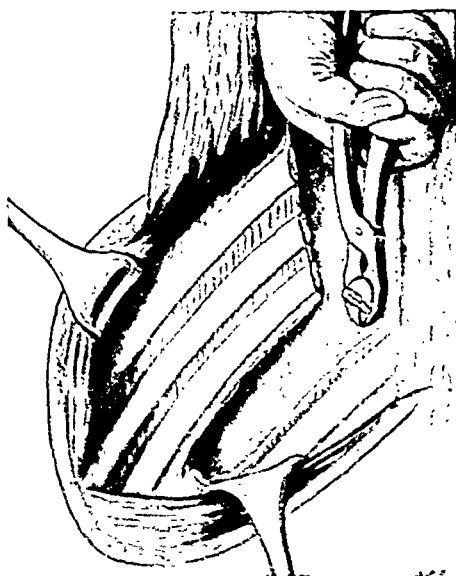


FIG. 85.—Posterior mediastinotomy: three inches of one rib have been removed, and three other ribs have been divided close to their junction with the spine. (From an actual operation.)



FIG. 86.—Posterior mediastinotomy: the hinged ribs are retracted and the pleura is being carefully stripped away from the mediastinum. The hands are drawn small in proportion. (From an actual operation.) (After *Lilienthal*.)

level, it is made on the left. Operations for the cure of cancer in the lower two to three inches of the œsophagus will be described later. I will now describe a left-sided partial œsophagectomy in detail.

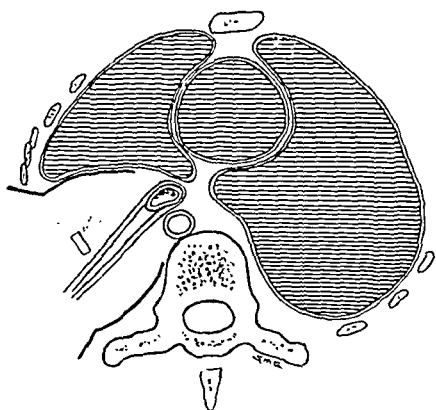


FIG. 87.—Diagram showing relationship of structures with œsophagus isolated by posterior mediastinotomy.

from its origin and reflected upwards the sinus dorsi is either retracted, or, if much of it is exposed, it is dealt with in like manner.

The posterior aspects of five or six ribs are thus exposed, covered towards the mid-line by the vertically placed tendons and fibres of the erector spinæ. This I now divide between clamps in a transverse direction at the upper and lower extremities of the wound, thus making a muscular flap which is turned towards the opposite side of the body and lies with the original skin-flap.

Three or four inches of the lowest rib exposed are now resected subperiosteally, the inner section of rib being as near the transverse process as possible (Fig. 85). The underlying pleura is exposed but not opened, and extreme care and gentleness are now required to press the pleura away from the under surface of the rib above. When this has been done I inject the intercostal nerve with absolute alcohol for anoci-association purposes, and then

The incision (Fig. 83) starts 2 in. above the level at which the growth is known to be, and extends from the mid-line outwards along the line of the subjacent rib for some 5 to 7 in. It then turns with a rounded-off corner vertically downwards for 5 to 6 in.; then towards the mid-line again parallel to the first incision. This flap including skin and subcutaneous fascia is now dissected up from the underlying structures (Fig. 84), and wrapped in warm moist cloths. As much of the trapezius muscle as is exposed is then detached and protected with cloths. The latis-

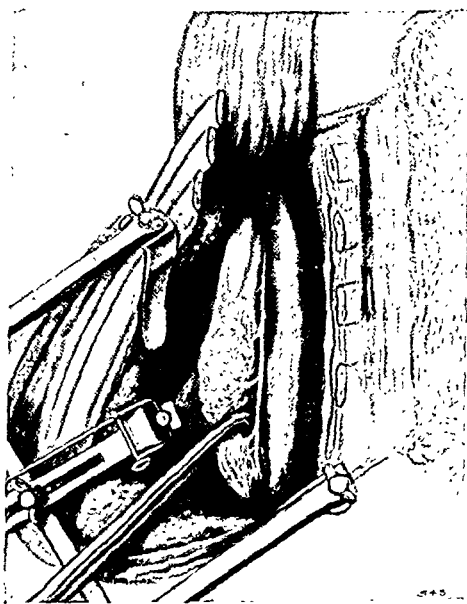


FIG. 88.—Posterior mediastinotomy; the pleura has been stripped from the mediastinum, and the aorta and the cancer-bearing area of the œsophagus are exposed. A light on the middle blade of the retractor illuminates the field of operation, and an electric diaphane transilluminates the œsophagus. (From an actual operation.)

section the rib as near the transverse

process as possible. This may now be retracted upwards and outwards by the assistant. The pleura is pressed away still further, and in all three or four ribs may be dealt with in this way. This is known as shingling the ribs. The accompanying diagram shows the result obtained (*Fig. 86*). The intercostal arteries must each be tied at both ends as each rib and artery is severed.

As a rib-retractor I have used Thomson-Walker's three-way bladder-retractor.¹⁸ This is powerful enough for the purpose, and at the same time allows a light to be fitted on to the middle blade which illuminates the interior of the thorax and makes identification of the structures very easy (*Fig. 87*).

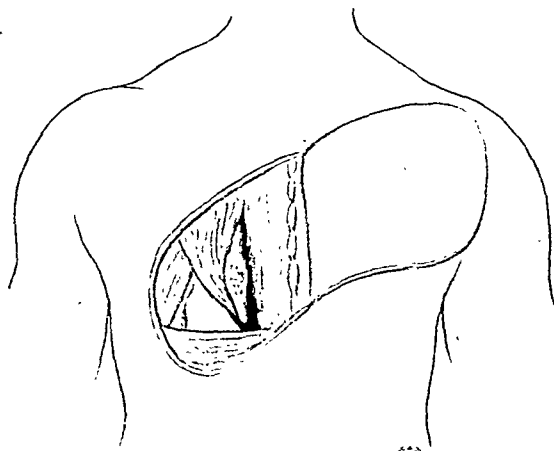


FIG. 89.—The œsophagus is lying in the newly-formed muscular bed.

In order that the blades may not damage the pleura, I protect this by cloths wrung out in a $\frac{1}{2}$ per cent solution of novocain. This helps to diminish the powerful pleural reflexes, and is especially useful if the pleura has been opened. The pleura lining the lateral aspects of the bodies of the vertebræ is carefully stripped from them, and the aorta readily comes into view. Before this is reached a little care must be taken not to remove the sympathetic and splanchnic nerves with the retracted pleura. This is a matter of no difficulty. A little further stripping now reveals the œsophagus. In order that its identification may be rendered easy, a sound may be passed into it, or, better still, Lilienthal's electric diaphane used.¹⁹ This is simply a small electric bulb attached to a rubber sound which transilluminates the œsophagus.

If preliminary investigations have been carried out accurately, the tumour is readily found, and its operability—or otherwise—may now be ascertained

(Fig. 88). If it is operable, matters should then proceed as follows: Two or three of the retracted ribs should be divided some 3 in. from the site of the primary division, thus making three or four ribs in all, portions of which

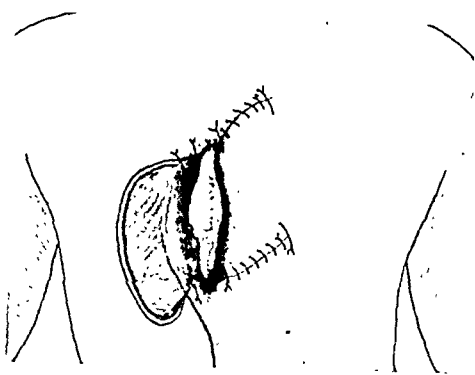


FIG. 90.—The plastic skin-flap is shown lying deep to the œsophagus.

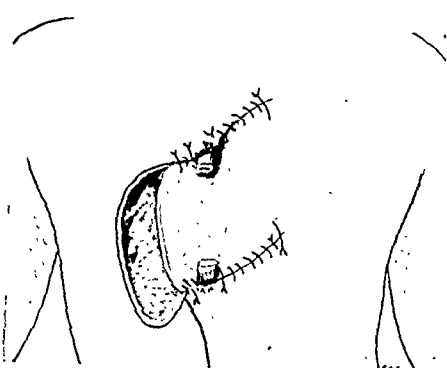


FIG. 91.—The cancer-bearing area of the œsophagus has been removed, and the flap may now be utilized to form the new œsophagus. The black line below in this and the preceding diagram shows the incision required for drawing up skin to fill the raw muscular space.

have been removed. The fibres of the vagi which are seen forming the plexus gulæ are divided with scissors, and the proximal ends swabbed with a small quantity of 2 per cent cocaine. The œsophagus is now separated from the loose cellular tissues in which it

lies by means of blunt dissection, or by means of an aneurysm needle curved at right angles which is carefully manipulated all round it until the gullet is lying free for some inches above and below the level of the growth.

In my animal experiments I pass the free portions of the trapezius above, the latissimus dorsi below, and the erector spinæ to the inner side, deep to the œsophagus, and suture these together with two or three interrupted catgut sutures so that the tumour-bearing area of the gullet is lying in the bed so formed (Fig. 89).

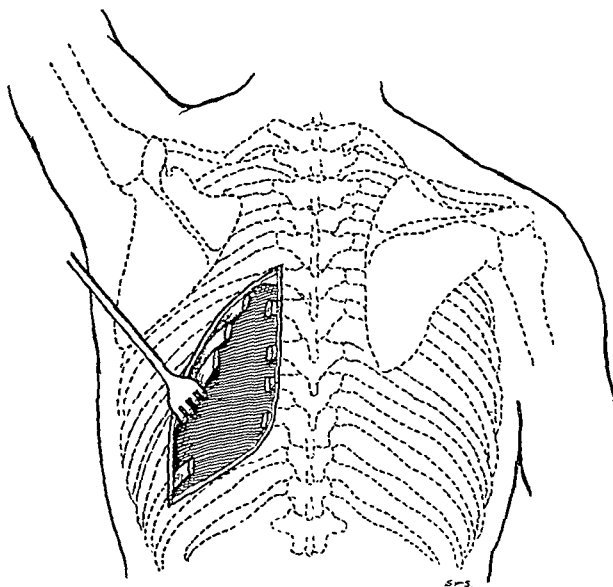


FIG. 92.—Torek's incision for the low posterior mediastinotomy or Lilienthal's operation. (After Lilienthal.)

In a similar way the skin-flap is also placed anterior to—that is, deep to—the œsophagus, and sutured as nearly as possible to the skin of the back

from which it was originally divided, thus closing off the mediastinum from the skin of the back completely, or perhaps with a small gap at the outer part of the wound (*Fig. 90*). This I now close by means of a small flap turned up from below, and have always succeeded in bringing skin-edge to skin-edge except where the œsophagus passes through.

As already stated, the lungs are carefully distended by increasing the pressure in the anæsthetic tube before the last stitch is drawn tight. If considered necessary, a water-seal drainage is also inserted into the thorax before the wound is finally closed. We now have the growth and an adjacent $1\frac{1}{2}$ to 2 in. of œsophagus on either side of it lying at the bottom of a groove in the back. If tension has not been too great, swallowing may be performed as well as before the operation, and if a gastrostomy was not necessary before the operation, it is not necessary now.

I have performed this operation upon eight animals with success, and have found no gangrene or rupture of the œsophagus to occur. I have performed posterior mediastinotomy upon two men with a view to radical removal of a growth of the œsophagus, but was unable to carry out the last stage on account of fixity of the growth. One made an uninterrupted recovery from the operation, the other had a large peri-œsophageal abscess and succumbed to mediastinitis in fifteen hours.

Some seven to ten days later the cancer-bearing area of the œsophagus is removed with as much normal tissue as feasible on either side of it (*Fig. 91*). This I would suggest should be

at least 1 in. in extent, and more if possible. The sutures are removed from the skin-flap, and it is separated from its base after infiltration with novocain. The inner and outer edges are dissected up and united to each other, while the upper and lower ends of the cylinder of skin thus formed are united to the upper and lower ends of the œsophagus respectively.

Lastly, the remaining inner and outer edges of the skin wound are undermined and drawn together, thus rendering the newly-formed œsophagus subcutaneous. Drainage tubes should be left in place for two to three days in case any leakage occurs.

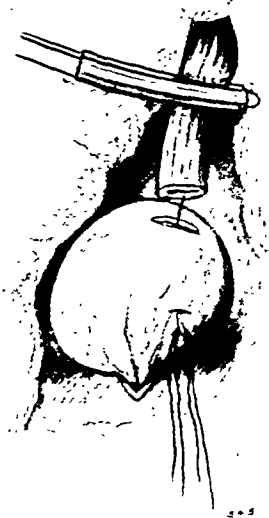


FIG. 93.—Lilienthal's operation. The lower two or three inches of the œsophagus have been removed and an opening made into the stomach. A needle bearing two long threads is passed from below through the main gastric opening to reach the œsophagus. (*After Lilienthal.*)

Operations for Radical Removal of the Lower Two to Three Inches of the Œsophagus.—If gastroscopy has shown that the adjacent portion of the stomach is not affected, the operation is best performed by means of a low left-sided posterior mediastinotomy; in this case a flap need not be raised, but the incision is made commencing some 2 in. from the mid-line opposite the middle of the vertebral border of the scapula, extending vertically downwards to the 10th intercostal space, and then laterally along the line of this intercostal space for from 5 to 6 in. The underlying muscles are retracted in the manner already described, and 3 to 4 in. of the 10th rib

removed. The 9th, 8th, and 7th ribs are now shingled as before (*Fig. 92*). The pleura and lungs are carefully retracted, and the lower few inches of the œsophagus and the upper surface of the diaphragm including the œsophageal opening are exposed. By means of blunt dissection the œsophagus is separated from the diaphragmatic opening, which is now incised towards the left and enlarged sufficiently to allow the cardiac region and fundus of the stomach to be drawn into the field of operation. At least 1 in. above and below the growth, the œsophagus is divided by means of the actual cautery, between clamps, the whole area being carefully protected by means of cloths. The opening thus made into the stomach is now closed and invaginated. Then the fundus of the stomach is drawn up-

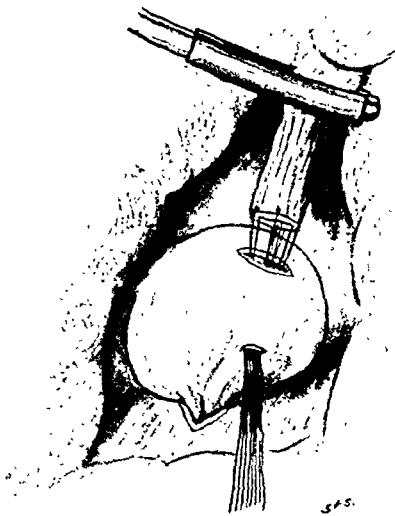


FIG. 94.—Each of the two threads is cut, and the four threads thus obtained inserted through the œsophagus at equidistant points. These threads are now utilized to intussuscept the œsophagus into the stomach. (*After Lilienthal.*)

wards so that it easily reaches 1 in. above the lower end of the remaining portion of the œsophagus, and an incision large enough to admit the œsophagus is made into it. About $1\frac{1}{2}$ in. below this incision a smaller incision is made into the stomach. Through the latter a needle bearing two long pieces of suture is passed, emerging again through the larger and upper opening (*Fig. 93*). The sutures are drawn through the larger opening and cut, so that four sutures are now available. Each of these is re-threaded on to a needle and passed through the wall of the œsophagus at four equidistant points (*Fig. 94*). Traction is now made upon these sutures and the œsophagus is drawn into—that is, intussuscepted into—the stomach, where it is retained by means of two or three sutures which pass through the wall of the stomach and œsophagus

FIG. 95.—The œsophagus is maintained in position by three sutures, and the smaller opening into the stomach closed. (*After Lilienthal.*)

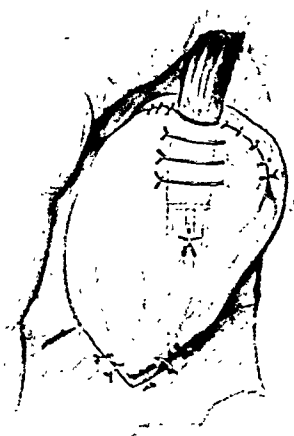
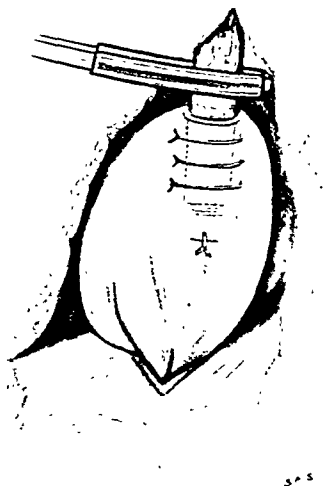


FIG. 96.—The region of the œsophago-gastric junction is invaginated and the stomach sutured to the diaphragm. (*After Lilienthal, slightly modified.*)

(Fig. 95). The traction sutures are now cut short and allowed to hang freely in the stomach, the smaller incision into which is closed by a stitch. The region of the stomach into which the œsophagus has been inserted is now still further invaginated by a series of Czerny-Lembert sutures (Fig. 96).

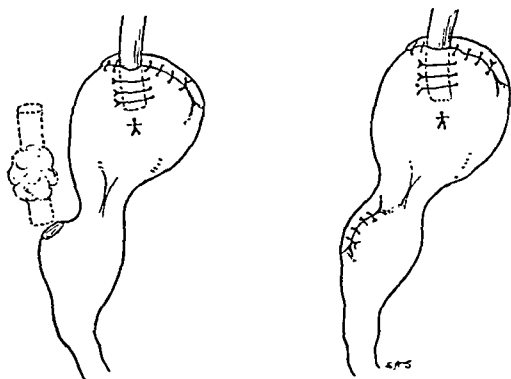


FIG. 97.—Diagram showing extent of Lilienthal's operation. (After Lilienthal.)

It is most important that the stomach should be united to the diaphragm where this is pierced; otherwise a large diaphragmatic hernia may develop. I have performed this operation successfully upon a dog but unfortunately neglected to suture the stomach to the diaphragm, and the animal succumbed nearly twenty-four hours later owing to a considerable amount of the abdominal contents passing into the thorax. Post mortem the œsophago-gastrostomy was found to be perfect, and did not leak even under

considerable pressure. This operation was devised by Lilienthal,²⁰ and its extent is shown diagrammatically in Fig. 97.

ABDOMINAL LAPAROTOMY.

Cases of cancer of the œsophagus arising at the cardia, whether primarily œsophageal or primarily gastric in origin, usually demand an abdominal laparotomy in order that their operability may be determined. If a jejunostomy is done as a preliminary operation, the possibility of a radical removal must be estimated at the same time, and, if it is found that an extensive resection of stomach as well as removal of the abdominal portion of the œsophagus is feasible, this may be performed entirely by the abdominal route (Fig. 98).

Technique.—An incision is made $\frac{1}{2}$ in. below and parallel to the left costal margin, extending well round to the back. The layers of the abdominal wall are divided in the line of the original incision, and the field of operation is exposed. The table is tilted so that the patient's head is at a higher level than his feet, and a large retractor is passed beneath the costal margin and used to pull this well upwards. If the area of operation is not thus rendered easily accessible, the lower two or three ribs must be divided through the posterior part of the original incision. This now allows a satisfactory view of the fundus of the stomach, the cardia, the abdominal portion of the œsophagus, and the œsophageal opening in the diaphragm. By means of blunt dissection the œsophagus is separated from the diaphragm, and a finger is passed into the mediastinum, separating the œsophagus still further from the loose cellular tissue around it. A previous X-ray examination may have shown dilatation or tortuosity of the œsophagus, and gives a pre-operative idea whether sufficient length of this organ may be drawn downwards into the abdomen. It

may, however, be advisable in either this operation or in that of Lilienthal to perform a section of the left phrenic nerve in the neck as a preliminary measure. When a sufficient length of the gullet has been drawn below the diaphragm a rubber tube is passed around it at the cardia, and this acts as a retractor. The œsophagus is now sutured by one or two stitches to the highest portion of the fundus of the stomach about 2 in. above the upper limit of the growth. One small opening is made into the stomach just below these sutures, and another into the œsophagus. A continuous suture is now taken and passed through all the walls of both viscera, taking up the posterior edge of the upper portion of the partially sectioned œsophagus. When this has been

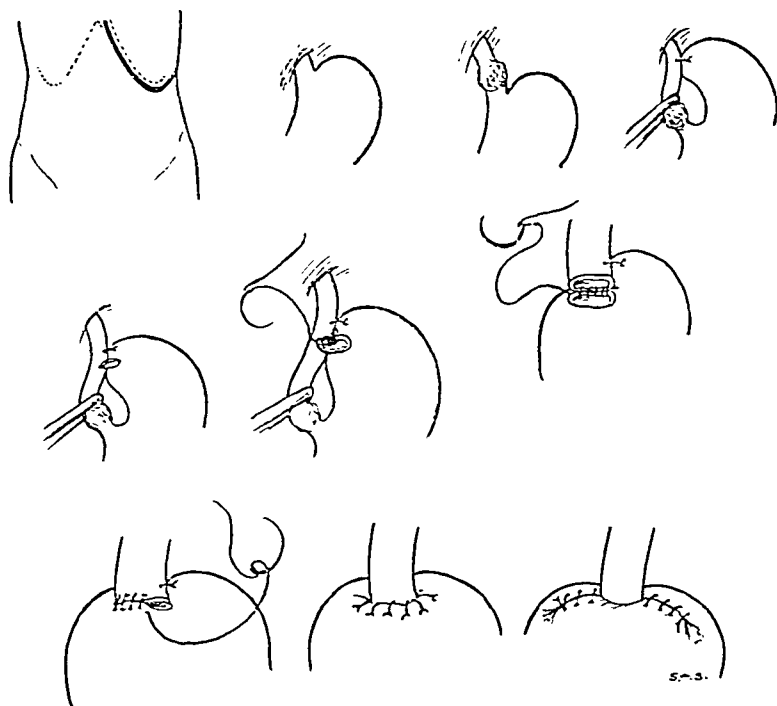


FIG. 98.—Diagram showing a method of removing a growth at the lower end of the œsophagus.

included in the suture the œsophagus is cut across a little further and the suture continued, and little by little the œsophagus is completely sectioned until, when this has been completely accomplished, the posterior half of its wall has been sutured to the posterior edge of the opening in the stomach. All that remains is to pass a suture uniting the anterior part of the wall of each of the two viscera. On either side of the anastomosis a seromuscular gastric suture is now made, causing an invagination of the anastomosed area. The lower end of the œsophagus and adjacent stomach are then removed as widely as possible, and the opening thus made into the stomach is closed and inverted in the usual way. I have three times set out to perform this

operation on human beings, but on each occasion found that, although the œsophagus could be withdrawn sufficiently into the abdomen, the gastric condition had advanced beyond the possibility of a radical removal. I have, however, done the operation twice upon a cadaver with a water-tight result.

Another operation I have performed upon the cadaver which should, I think, be quite feasible upon the living is as follows: The abdomen having been opened as just described, and the œsophagus mobilized and the tumour

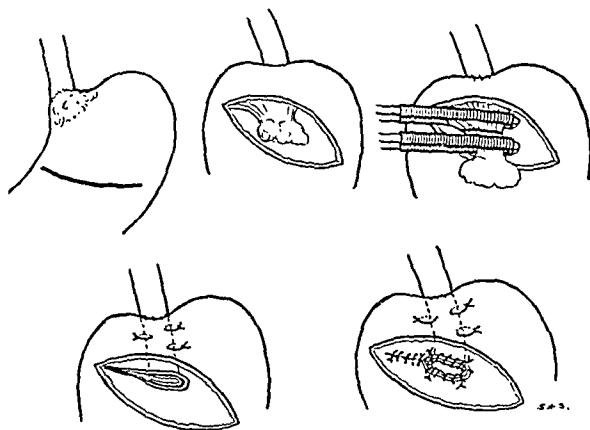


FIG. 99.—Diagram showing another method of removal of growth at the cardia.

found to be operable, an incision is made into the stomach about its middle, extending almost from the lesser to the greater curvature. A finger is now passed into the cardia, which is drawn through the gastric opening—that is to say, the lower end of the œsophagus and adjacent stomach are intussuscepted into the remainder of the stomach—and the tumour drawn outwards through the gastric incision. A clamp is then applied a good inch away from the growth, which, together with the adjacent œsophagus and stomach, is removed by means of a cautery. Three or four sutures are passed between the non-intussuscepted portion of the œsophagus and the serous wall of the stomach at the site of intussusception. Now, passing to the area where the œsophagus and stomach have been sectioned, these two are united to each other by means of through-and-through sutures, special sutures being passed in order that the left gastric artery may be securely ligated. Two or three sutures are also passed through the walls of the stomach picking up the intussuscepted portion of the œsophagus. The gastric opening is then closed in the usual way. (See Fig. 99.)

COMBINED OPERATIONS.

In Torek's famous case²¹ which was demonstrated alive and well a year ago in New York (twelve years after operation),²² he performed a posterior mediastinotomy with section of the œsophagus *in situ* and invagination of the lower end (Fig. 100). An incision was then made in the neck (Fig. 101), and the upper portion of the œsophagus containing the tumour drawn through this incision (Fig. 102) and passed under the skin of the anterior wall of the thorax, so that it emerged through an incision in the skin at the level of the 2nd intercostal space. The patient still swallows well through an anastomosed rubber tube.

Eggers, of New York, has also had a successful case.²³

This might be called the combined mediastino-cervical operation. An abdomino-cervical operation has also been performed: the stomach is mobilized after the method of Kirschner,²⁴ and the œsophagus separated from its diaphragmatic hiatus. The œsophagus having been exposed by the cervical route, it is drawn upon until almost the whole of it emerges through the neck, the stomach coming to lie in the posterior mediastinum (*Fig. 103*). The tumour-bearing area is now excised, and the gullet sutured and replaced into the neck.

Levy,²⁵ of Berlin, suggests Friederich's operation of subperiosteal excision of the last six ribs, thus causing collapse of the thorax so that the œsophagus can easily be reached. The diaphragm is then divided and transplanted upwards. Both the œsophagus and the stomach are now lying close to the skin, and the affected area may be excised, leaving the cut ends of the œsophagus and the stomach extracutaneous, where they may later be anastomosed. A modification of this method was successfully used by Hedblom,²⁶ and also by Zaaïjer.²⁷

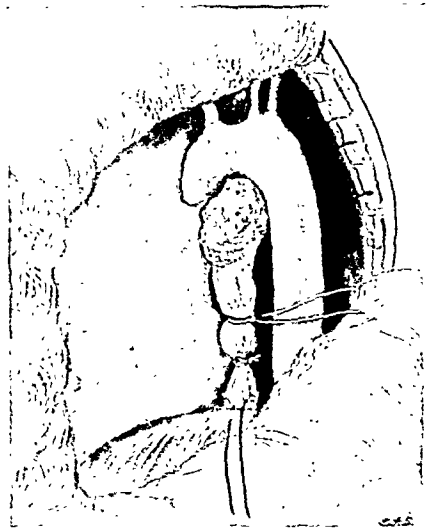


FIG. 100.—Torek's operation. Posterior mediastinotomy, with division of the œsophagus *in situ*. (After Torek.)

Another abdomino-cervical operation which has been suggested consists of first exposing the cardia by laparotomy and dividing the œsophagus from the stomach. The gastric opening is closed.



FIG. 101.—Diagram showing line of incision for exposure of the cervical œsophagus.

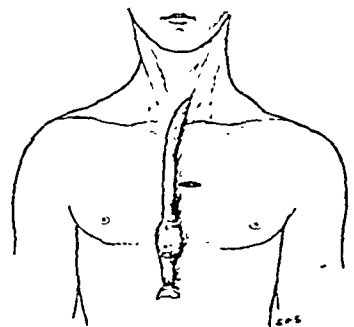


FIG. 102.—The œsophagus withdrawn through the cervical incision in Torek's case. (After Torek.)

A malleable sound is now passed from the mouth to the lower end of the œsophagus, to which it is secured by means of a stout thread. The end of the gullet is surrounded by oiled silk, which is tightly tied round it, the ends of this ligature being left long.

Through a cervical incision the œsophagus is exposed, and when traction is made upon the peroral sound the lower part of the œsophagus is intussuscepted into the upper

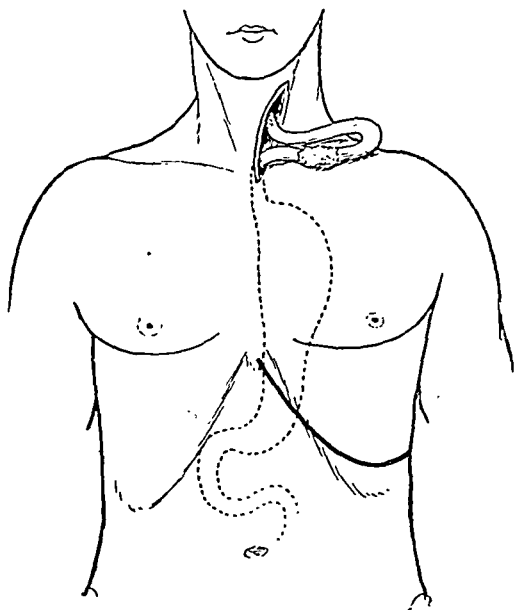


FIG. 103.—Diagram showing exteriorization of the œsophagus through a cervical incision, with displacement of the stomach into the thorax after mobilization.

(Fig. 104) and the long ligature appears in the neck. This is withdrawn through the cervical wound, and the whole œsophagus together with its growth exteriorized.

I have performed this operation upon a dog, but consider it of doubtful value in a case of cancer of the œsophagus, when so many much more satisfactory operative procedures are open to us.

CONCLUSIONS.

As already stated, cancer of the œsophagus gives early symptoms. Further, this particular type of tumour remains localized to the affected organ long after its presence can definitely be diagnosed. Thirdly, glandular metastases from carcinoma of the œsophagus are the exception rather than the rule, and the majority of sufferers from this complaint do not die from carcinoma but from starvation.

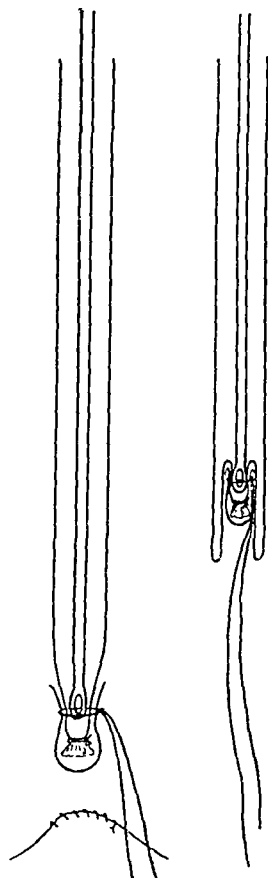


FIG. 104.—Diagram showing a method of displacement of the œsophagus by means of a sound passed through the mouth.

It would thus appear that cancer of the œsophagus often is, and almost always should be, diagnosed at a very early date; that its surgical removal should be followed by complete freedom from local recurrence; and that later glandular recurrence should occur only in the minority of cases.

I am strongly of opinion that the operations suggested are feasible. It will be remembered how Billroth began operating on the stomach some forty years ago; many of his patients died, but to-day operations on the stomach are performed by all surgeons with extremely low mortality, and yet our operations and those of Billroth are the same except for very small points of technique. Similarly with growths of the large intestine; at the beginning of the present century these were looked upon as inoperable, whereas at the present time their removal is an everyday occurrence.

With more adequate education and earlier investigation of cases, and the application of the principles which I have enunciated, there would appear to be no reason why malignant disease of the gullet should not be treated so effectively that before long, instead of this disease claiming 100 per cent of its victims as it does at the present time, it will be the most favourable type of cancer with which the surgeon has to deal.

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ANÆSTHESIA OF THE BRACHIAL PLEXUS.

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AFTER working for some time in the surgical department of a hospital which has no trained anæsthetist, and where one's colleagues are much too busy to attend to anæsthetics, the value of a reliable local anæsthetic, entirely under one's own control, quickly becomes apparent—so much so that, after one or two experiences with general anæsthetics which nearly ended in disaster, regional anæsthesia is now used as a routine in all suitable cases, whereas previously it was only employed as a last resort in cases too ill to stand a general anæsthetic.

Under such circumstances, when an efficient and reliable technique for producing local anæsthesia has been developed, half the anxiety of a major operation is taken away, and any surgeon will find that the time and trouble required to gain the necessary skill is more than worth while. From the point of view of the patient, if proper psychological precautions are taken, the results are equally satisfactory, for he is saved much post-operative discomfort, which sometimes may even amount to suffering. The eagerness of patients to have a local anæsthetic, after its reputation has got round the wards, is perhaps the best proof of this. Its advantages, however, are not only confined to the patient and his doctor; they are shared by a hard-driven nursing staff, whose work is materially reduced because their post-operative cases have not spent the previous hour soaked in ether. And finally, the operating theatre budget, in China at least, feels its good effects.

Because of the foregoing considerations, and the fact that up till now brachial-plexus block does not seem to have attained the reputation it deserves, I venture to describe the experience gained from a series of 56 consecutive cases.

In his Halsted Memorial Address at Johns Hopkins Medical School, Baltimore, Rudolf Matas¹ mentions that during the winter of 1884-5 Halsted, after injecting cocaine around the nerves at the root of the neck, successfully performed an operation on the brachial plexus. This was the period during which he was doing his pioneer work on local anæsthesia, and it is the first attempt to block the brachial plexus of which I can find any record. In those early days, before novocain was discovered, the method never gained great popularity, probably because people began to realize the danger of injecting cocaine subcutaneously; and Halsted, its originator, was the kind of person who always kept his new ideas to himself until he had proved their worth to his own satisfaction, and, even then, often he did not publish them.

Very little was heard of this method, therefore, until Kulenkampff,² about 1910-11, elaborated the technique of supraclavicular injection which usually goes by his name. About the same time Hirschel³ published a method

of infiltrating the plexus from below; but from all accounts this is not as simple, certain, nor as safe as that recommended by Kulenkampff, and in this series of cases it has not been used.

Others, including Crile, have injected novocain after exposing the plexus through a supraclavicular incision. In view of the good results obtained by Kulenkampff's method, a further complication of the technique seems to be unnecessary, but perhaps might occasionally be required under very exceptional circumstances.

The technique elaborated by Kulenkampff takes advantage of the fact that practically the whole nerve-supply of the arm is gathered together on the upper surface of the first rib, immediately external to the subclavian artery, which nearly always forms a convenient landmark by means of which the nerve-bundle can be located.

It may be objected that in this region there are too many important structures which may be easily injured by blindly inserting a needle. In actual practice, however, it seems to be remarkably free from danger if the technique is carefully followed. The subclavian artery may be adequately protected by a finger placed on its antero-superior surface, from a point immediately outside of which the injection is made. Injury to the pleura is easily avoided if the injection is made immediately paræsthesias are obtained; or, should they not be noticed, the point of the needle must always be made to impinge on the first rib before any solution is injected. Should the needle inadvertently pierce either of these structures, sufficient evidence of the fact is always at hand. In the first case, blood flows rapidly from the needle, and in the second case the patient complains of pain. In this series the subclavian artery was pricked twice: once in a four-year-old child whose artery was impalpable, and once in a fat man whose neck was very thick and short. In both these cases there was no doubt whatever where the point of the needle was, and no harm resulted; the needle was withdrawn, and, after its direction had been corrected, the usual technique was continued. In each case the result was in every respect satisfactory, and there were no untoward consequences of the mishap. That this accident is relatively unimportant is confirmed by the experience of most of those who have used the method.

As regards injury to the pleura, as far as I know, it has not occurred in these cases. Intrapleural injection would almost certainly produce pain or a reflex cough. Hirschel, in his text-book, quotes Heile⁴ as having seen one case in which the pleura was injured. There was subsequent pleurisy, which passed off without leaving any ill-effect.

Hartel and Keppler record that paralysis of the diaphragm occurred in 17 out of 200 cases, and suggest that this was due to paralysis of the phrenic nerve on that side. Hertzler,⁵ in commenting on this, suggests that the five cases of pain in the chest and dyspnœa which these authors record were really due, not to puncture of the pleura, but to massive collapse of the lung, the result of phrenic paralysis.

In this series of cases we have seen no accidents of this kind, and, although paralysis of the diaphragm may have been overlooked, it certainly produced no symptoms. In fact, the method has seemed to be remarkably free from danger and complications of any kind.

TECHNIQUE.

No special instruments are necessary. A fine 5- or 6-cm. needle, connected to a 20-c.c. Record syringe, is all that is required. A special syringe having a bayonet-fitting eccentric joint is more convenient, but by no means essential. The needle, however, should be quite sharp, for if it should by any chance pierce the subclavian artery it will only make a fine hole which immediately closes up by itself, whereas, if its point is blunt, it is conceivable that during its passage through the artery the coats might be torn, a result which at any rate is undesirable. In addition to a suitable syringe, 30 c.c. of 2 per cent and a quantity of $\frac{1}{2}$ per cent novocain solution should be at hand. Adrenalin is added in the proportion of 3 drops to every 10 c.c. of novocain solution used.

Half an hour before the injection is to be made, the patient is given a hypodermic injection of scopolamine gr. $\frac{1}{100}$ and morphia gr. $\frac{1}{6}$. In some patients this time relationship is important, because scopolamine and morphia causes them to over-react to the slightest stimulus, and removes whatever self-control they possess. If administered too late they are frightened by the injection; if given too early, or if two doses are employed, they may be over-excited, and the procedure becomes very difficult.

The injection is as a rule made on the operating table, which should be well padded and comfortable. In summing up his general impressions of the operation, a patient who has been lying on a hard, uncomfortable operating table for an hour is not likely to separate the uncomfortable sensations thus received from those which come from the actual operative manipulations.

The patient's head should be in the middle line, and slight traction should be made on the arm, in order to bring down the clavicle. If, however, the head is turned to the opposite side, and the arm pulled down too much, the skin over the supraclavicular region is sometimes made so taut that the artery cannot be palpated, and thus the best guide to the brachial plexus is obliterated.

There are several ways of finding the correct spot for the injection. The best, and the one nearly always available, is to feel with one finger the subclavian artery. A small intradermal wheal is made 1 cm. above the clavicle, immediately outside the palpating finger. Sometimes, in thin patients, the plexus can be felt and rolled beneath the skin, on the upper surface of the first rib. In other more difficult cases the external jugular vein forms a reliable guide. The patient is told to puff out his cheeks, and the vein stands out clearly. The injection is made from a point 1 cm. above the clavicle, immediately outside the vein. This latter spot corresponds to a point 1 cm. above the clavicle in the exact midclavicular line, and it can be found in this way should the external jugular vein be invisible. While inserting the needle, the anatomical relationships of the first rib should be borne in mind: a help not to be despised is to study a diagram of these for ten minutes beforehand. The direction of the needle is inwards, downwards, and backwards, as close as possible to the subclavian artery. As soon as the needle has pierced the deep fascia it is pushed onwards about $\frac{1}{2}$ cm., and, if the patient is not too sleepy, paræsthesias will be felt. If not, the needle should be gently

moved from side to side in a direction transverse to the main axis of the plexus. If this manœuvre does not produce paræsthesias, the needle should be pushed on till it rests on the first rib, then gently withdrawn a few millimetres, and the novocain injected. For the average patient 15 c.c. of 2 per cent solution are sufficient, but in fat people 20 c.c. may be used; in children 10 c.c. are sufficient. It is the experience of most people that weaker solutions do not produce good results. In addition to this, I have adopted a modification of the original technique which I believe was suggested by Labat.⁶ The needle is withdrawn outside the deep fascia and re-inserted in a direction upwards and inwards, towards the transverse process of the sixth cervical vertebra. Five c.c. of 2 per cent solution are injected. This will diffuse upwards and downwards in the loose intermuscular connective tissue where the nerves are to be found. Finally, 5 c.c. are injected just at the outer border of the first rib, in order to block any abnormal branches which may join up here.

When this is finished, a subcutaneous ring of $\frac{1}{2}$ per cent solution is injected round the arm at the level of the deltoid insertion. This serves to block the fibres of the cervical plexus. This subcutaneous ring may perhaps be advantageously placed a few inches above the upper margin of the incision, whatever the position of the latter may be.

If the region of the shoulder-joint is to be explored, it is necessary instead to inject some $\frac{1}{2}$ per cent solution subcutaneously along the line of the clavicle, and also to infiltrate the inner axillary wall as high up and as close to the ribs as possible. Injection fanwise from one suitably-placed intradermal wheal will easily gain this end. In this way the intercosto-humeral nerve, and the clavicular, pectoral, humeral, and supra-acromial branches of the cervical plexus are blocked at a higher level than when a deltoid ring is used.

After the injection is finished, the limb is surrounded with fresh towels and prepared for operation, and by the time this is completed and the surgeon has put on his gloves, anæsthesia will usually be complete; it will last from one to three hours. It is seldom necessary to wait longer than ten minutes. It is sometimes stated that the rapidity with which anæsthesia supervenes is proportional to the ease with which paræsthesias are obtained on injection; but this has not been found to hold good in the present series of cases.

At this stage it is necessary to decide whether a further hypodermic injection shall be given, first-stage general anæsthesia induced, or the operation immediately proceeded with. The decision on this point is made after taking into account the patient's mental condition and psychology. From his point of view it is most important to see to his mental and physical comfort while on the table, for there is no more reason why he should spend an hour in intense mental discomfort than there is for his blood to be saturated with ether for the same period of time. Some patients are perfectly happy and comfortable without any further attention; others require something to quiet their very natural alarm. We have found the following rules very satisfactory for general guidance in all types of local anæsthesia. Sensation is first tested roughly to see whether anæsthesia is satisfactory, and if not, ether is given at once, the injection being counted as a failure. If the patient is wakeful and seemingly uninfluenced by the first hypodermic injection,

another one is given; but if the first injection has produced a talkative, rather excited patient, he is given either ether or chloroform until he goes to sleep. If a careful anaesthetist is available, a few drops of chloroform will gain this end quickly. The patient will then, as a rule, sleep for the rest of the operation without any further medication. This is a most satisfactory method of dealing with patients who are disturbed by their unusual environment, and we never hesitate to use it when there is the least indication.

To estimate accurately the value of a method like brachial-plexus block, and to compare it usefully with general anaesthesia, is a difficult task. To compile a list of cases strictly comparable is almost impossible, so that our impressions must be considered in making a final estimate. After doing it over fifty times, it is impossible to escape the conclusion that a patient is in a better condition at the end of a major operation done after brachial-plexus block than when a general anaesthetic has been used. Even when the results of injection are not perfect from a neurological point of view, sometimes the practical results are most evident. The following case is a good example of this :—

A soldier, age 23, had a gunshot wound involving those larger branches of the brachial plexus situated beneath the pectoralis major. The ulnar, median, musculocutaneous, and musculospiral nerves were all involved in dense scar tissue which obliterated all the normal relationships. Towards the end of the operation, when the musculospiral nerve was being dissected free, a traumatic aneurysm about the size of a walnut was broken into and had to be removed. The whole operation lasted two hours and fifty minutes from the time of injection. The ordinary technique was used, and from the beginning a first-stage anaesthesia was induced with ether, and during the whole period 11 oz. of ether were given by the open method. Dissection of the nerves produced no response whatever, but traction downwards always made the patient call out, probably because it was transmitted to the roots above the blocked area. The patient's pulse at the beginning of the operation was 80 and at the end 90; his general condition showed hardly any appreciable change.

To make a proper neurological examination is very difficult, for Chinese patients do not notice fine points of difference. An intelligent, wakeful patient is very rare. Experience leads me to believe that protopathic and epicritic sensation are nearly always completely abolished, but muscle sense seems sometimes to be retained. Paralysis also is complete or nearly complete in most cases. A recent opportunity to examine one of these incomplete cases showed that painful sensations and muscular power were completely abolished, but pressure sense was present all over the arm, and the patient called out for the first time when hot eusol was poured over the wound. Reaction to cold was not tested, but in other cases it has been abolished when heat sensation was present to some degree over the area tested.

Brachial-plexus block has been found equally effective in all classes of patients. The results in children, as with other types of local anaesthesia, have been most gratifying. The child is anaesthetized, the injection made, and the anaesthetic stopped; he will then sleep until the operation is finished. This procedure, used in a child of 4, with extensive suppurating osteomyelitis

involving the whole length of the radius, was probably life-saving. In one case the brachial plexus was blocked on both sides at the same time. There were no alarming symptoms, and the result was eminently satisfactory.

COMPLICATIONS.

Our experience has been remarkably free from complications of all kinds. Excluding the puncture of the subclavian artery already referred to, there have been only two. One man had paralysis of the whole arm which lasted for twenty-four hours, and then rapidly and completely cleared up. Raeschke⁷ records such a case in a boy of 15. The plexus was uniformly involved, but within two and a half weeks movement returned at the shoulder, elbow-joint movements also returned later, and within three months there was no abnormality whatever. There is, as far as I know, no record of any permanent disability to be found in the literature.

The second complication was a reaction which may perhaps be attributed to novocain. Immediately after injection the patient's pulse became soft and rapid (135), and at the same time the respiration was shallow and fast. However, within fifteen minutes she had returned to her former condition, which, incidentally, was none too good. This is the only example of a novocain reaction which we have seen in a series of over 500 operations performed under local anæsthesia.

In two cases a second injection of 10 c.c. was given because, at the end of about ten minutes, anæsthesia was incomplete. In each of these two cases the final result was quite satisfactory.

RESULTS IN THE FIFTY-SIX CASES.

The results of 56 consecutive cases were as follows: in 50 the result may be classed as either perfect or satisfactory, 2 as indifferent, and 4 as failures. Among the four failures were the first two cases on which I had used the method for four years. A third failure was probably due to the use of 1 per cent novocain after reading an article on the dangers of employing too strong solutions. Two cases (one of which is classed as indifferent) were so frightened that it is impossible to say to what extent they were anæsthetic, and these were not suitable subjects for local anæsthesia. In the last case with an indifferent result it was impossible to assign any reason for the failure but inaccurate technique. The patient had already undergone two operations with a satisfactory result as far as the anæsthetic was concerned. The rest will be classified in a little more detail later on. On the whole they were most successful. In only one was a third-stage general anæsthesia necessary, and this but for a few moments in order to permit strong retraction of the deltoid.

In 5 cases ether was given, the average amount being $2\frac{1}{2}$ oz. per hour. This figure includes the case already referred to in which third-stage anæsthesia was induced, and a child who was fully anæsthetized before injection. In 6 cases chloroform was used to produce sleep, the average amount required being one drachm. Lately we have used this more and more freely, without any ill-effects.

RESULTS IN THE 56 CASES OF ANÆSTHESIA OF THE BRACHIAL PLEXUS.

NATURE OF OPERATION	No.	PERFECT	SATIS- FACTORY	INDIF- FERENT	BAD	REMARKS
Amputation	2	1	—	—	1	Bad result due to fright
Osteomyelitis in upper end of humerus	2	1	1	—	—	Case felt pulling on deltoid; refused anæsthetic
Plating fractured neck of humerus	1	—	1	—	—	Full anæsthesia necessary when deltoid pulled
Neurolysis	3	1	2	—	—	
Open reduction of old dis- located shoulder ..	1	1	—	—	—	
Excision and drainage in compound fracture ..	1	1	—	—	—	
Excision of tuberculous glands in mid-brachial region	1	1	—	—	—	
Excision or arthroplasty of elbow	10	7	3	—	—	
Breaking down adhesions in elbow-joint	2	—	—	1	1	1st case
Operative reduction of fracture of lower humerus	2	1	1	—	—	
Drainage and scraping of sinus	3	3	—	—	—	
Plating fractures of ra- dius and ulna	3	3	—	—	—	In two of these cases both bones were plated
Bone-graft of ulna ..	1	1	—	—	—	
Draining compound frac- ture of radius and ulna	2	2	—	—	—	
Osteomyelitis	2	2	—	—	—	
Cellulitis and gunshot wound of forearm ..	5	2	2	—	1	
Amputation through fore- arm	1	1	—	—	—	
Cellulitis and abscess of hand	4	3	—	—	1	1 per cent novocain used
Bone tuberculosis of hand and wrist	6	5	—	1	—	
Amputation of fingers ..	4	4	—	—	—	
Totals	56	40	10	2	4	

In all the cases which are classed above as perfect or satisfactory, the average increase in the pulse-rate during the operation was 11.9. Excluded from this computation are a certain number of cases in which the pulse at the end of the operation was a good deal less than at the beginning. Fig. 105 is a composite pulse and temperature chart which shows very well the average reaction of the non-febrile cases in this series.

The method finds its most useful application for major operations about the elbow-joint and on the forearm. In operations about the shoulder-joint it is difficult to abolish muscle sense in the deltoid, and retraction of this muscle sometimes wakes the patient. It has been used successfully several times for operations on the hand, in spite of the fact that infiltration of the ulnar and median nerves at the wrist answers the purpose equally well, because of the necessity, in this country, of developing one standardized technique for teaching purposes.

In the table given on the preceding page a case is classed as perfect in which the patient appeared to receive no sensations whatever from the operation area. Those classed as satisfactory apparently retained some degree of muscle sense, but obviously felt no pain. The rest were definitely not completely anæsthetic, so that some other form of anæsthesia became imperative.

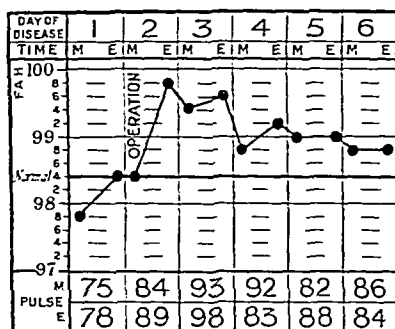


FIG. 105.—Composite chart.

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THE SEVENTH CONGRESS OF THE INTERNATIONAL SOCIETY OF SURGERY AT ROME, APRIL, 1926.

THE Seventh Congress of the International Society of Surgery was held in Rome on April 7-10, 1926, the inaugural ceremony taking place at the Campidoglio on the Capitol Hill, and the scientific sessions at the Policlinico. Very lavish care had been spent over the arrangements by our Italian hosts, who showed us the sights of Rome, fêted us, and feasted us in a manner worthy of the Eternal City. There were several sessions devoted to the watching of operations in the various hospitals, and the account given on p. 172 is that of a visit to the wards and operating theatre of Professor Alessandri at the Policlinico. The business meeting of the Congress was notable for the fact that it was almost unanimously decided to reopen the portals of the Society to all those who had been members before the War, when their respective nations had become members of the League. The next Congress is to be held at Warsaw in 1929.

ADDRESS DELIVERED BY HIS EXCELLENCY SIGNOR BENITO MUSSOLINI, THE
HEAD OF THE GOVERNMENT, AT THE INAUGURAL MEETING
OF THE INTERNATIONAL CONGRESS OF SURGERY.

“ I bring the welcome of the Italian Government to you, eminent masters of that surgeon’s art thanks to which medical science through the centuries has achieved some of its greatest and most glorious victories. The word which designates your art, gentlemen, does not fully indicate its ideal bearing and human worth. The Greek root of the word ‘surgery’ has but a modest meaning, ‘work of the hand’; but the most luminous qualities of the mind and the deepest energies of character must guide and support that hand in the work it performs with ever-growing success in its efforts to save, with the help of the knife, human lives threatened by disease that is no longer invincible.

“ Dating back to most remote ages, your art first rose to the dignity of a science on Italian soil, and, casting off its first profane followers, received its laws and became a science under the learned guidance of the school of Salerno. Proceeding from that school it was honoured in the Renaissance by the four great masters to whom it still looks up with devotion as its most revered patrons, Andrea Vesalio, Wurtzius, Paracelsus, and Ambroise Paré.

“ I need not remind you that Paré, as surgeon to Francis II, Charles IX. and Henry III, accompanied their armies in their long campaigns, and when bending over the grievously wounded soldiers he succeeded in saving their fast-ebbing lives, more especially thanks to the system he first introduced of tying the arteries instead of cauterizing them in cases of amputation. When

imminent death retreated before the prodigy of restored life, Ambroise Paré, raising his eyes to heaven, used to exclaim, with exemplary modesty: 'Je le pançai, Dieu le guarist'. But no, he did not only dress the wounds, he cured. And where Death was destroying, Man intervened to restore life.

"The seven volumes of one of the most famous works on the history of surgery are entitled *De Corporis Humana Fabrica*. Masters of anatomy, you are indeed the second makers of the human body. With firm wrist, cunning hand, stern heart, and cool, lucid brain, you have gradually snatched from the insidious attacks of disease most of the obscure regions of the body.

"As a soldier in the great war I had an opportunity of experiencing for a long time your skill on my own body, and so did millions and millions of wounded.

"I greet in you the wonderful saviours of innumerable lives, the victorious heroes of the ambulances. But while soldiers get rest—for even the fiercest wars must have an end—you never rest from your war on disease. Until the last days of your life you remain ever on the field of action, intent in the effort to save the wounded in life's conflict, whose tragic hosts are yet more numerous than those who fall on the field of battle.

"If all men worthy of that name are soldiers in their country's hour of trial, you are the untiring soldiers of the daily battle against disease.

"I am glad to see you assembled in such impressive numbers as our guests in Rome, and beg you to accept, with my cordial greeting, the expression of my admiration and esteem."

A RÉSUMÉ OF THE SCIENTIFIC SESSIONS.

The Treatment of Uterine Cancer by Radiation.—The discussion on this subject was occupied chiefly by details of methods and dosages, and it was difficult to gain any clear idea as to whether early optimism has been justified or not. Regaud (Paris) attaches great importance to the use of radium applied in the vaginal and cervical canals rather than the insertion of needles. He considers that radiation of an infected case involves serious danger of septic complications. In regard to results the following are the percentage figures of cure on a five-years basis:—

	PER CENT
All cases together ..	15 to 20
Inoperable cases ..	5 to 15
Operable cases ..	30 to 40
Early cases ..	40 to 60

He concludes therefore that, except under special circumstances, radiotherapy is to be chosen rather than hysterectomy.

Beuttner (Geneva), whilst admitting the imperfection of present statistical information, considers it proved that radiation gives as good or better results than operation, in early as well as late cases of cancer of the cervix. Cancer of the body of the uterus, on the other hand, gives the best results after hysterectomy.

Recasens (Madrid) devoted his paper chiefly to the intricate and important subject of the dependence of the biological effects of the radiation upon

time and dosage. He held it proved that the application of small doses for short periods caused radio-immunization and rendered effective treatment impossible. The maximum dose of radium applied for a short time caused the greatest biological effect.

Forsdike (London) was much less optimistic than other speakers. He described the results of treatment by radiation in 197 cases. In 7 early cases treated by radiation alone, 6 were well for periods varying from $1\frac{1}{2}$ to 5 years. In 50 advanced cases, only 6 per cent were alive after 4 years. In his opinion radium and X rays should be used before and after operative treatment, but the latter should never be withheld where it is possible.

Abscess of the Liver.—The frequency of amœbic abscesses of the liver is shown by the fact that Domenici (Sassari), who introduced the subject, was able to refer to 264 recent cases. Both he and Petridis (Alexandria) paid tribute to the work of Rogers, especially in regard to the preventive treatment of amœbic abscesses by emetine. By such treatment surgical intervention was often avoided. Petridis described an efficient operation for exploration and drainage of the abscess. He makes a horizontal incision through the chest wall from the mid-axillary line to the outer border of the rectus, dividing the 6th, 7th, 8th, and 9th ribs. The diaphragm is cut in the same line, and the cut edges are sewn to the skin, thus shutting off the pleura from contamination.

The Treatment of Tumours of the Brain.—It is interesting to recall the fact that this was one of the subjects for discussion at the last International Congress of Medicine, held in London in 1913. On that occasion large series of cases were related, and the general problem of whether decompressive or radical operations were really justified by results was debated. On the present occasion discussion was chiefly confined to the details of operative technique, although Sargent's paper, which is presented in full on p. 102, deals with results.

Brun (Lucerne), who introduced the discussion, based his remarks on 458 cases operated on during twenty-three years. He uses local anæsthesia, the patient sitting up and resting the head on the folded arms. The scalp is only partly shaved, towels being sewn round the margin of the shaved area. After trying all sorts of saws and other mechanical devices, he has come back to the use of Krause's bone-cutting forceps introduced through a small drill-hole. The flap of bone raised is always a large one, but the incision through the scalp is made a few centimetres at a time, and every bleeding vessel caught with Kocher's forceps or tied. Similarly each part of the groove in the bone is plugged with gauze wrung out of hot iodoform-impregnated gelatin. After the whole flap has been cut down to the dura, a small cut is made into each side of its base, and the decision arrived at whether to proceed or to wait for a second-stage operation. Nearly always the whole operation is done in one stage, although a pause is made after the cutting of the flap, the patient being given a drink. If a two-stage operation is done, the bone is not separated from the dura until the second stage, so as to avoid obscuring the latter by blood-clot. Primary water-tight suture of the dura is regarded as essential; any loss of dura is made good by flaps of aponeurosis or flaps of fatty tissue.

De Martel (Paris) also dealt only with the technical aspect of the question. He agrees with Brun in the importance of absolute hæmostasis and in the use

of local anæsthesia, but he lays stress on speed of operating, and for this end he uses a special motor-driven saw. The dura should not be opened until cerebral tension has been reduced by lumbar or ventricular puncture or by intravenous hypertonic injection. It was urged that ablation of a tumour should always be attempted, decompression being reserved for hopeless cases.

Lozano (Saragossa) laid stress on some of the same points as de Martel, namely, the advisability of attempting extirpation of the tumour rather than trusting to decompression; the desirability of using a one-stage rather than a two-stage method; and the importance of not operating under conditions of greatly raised intracranial tension. He considered that the mortality of operation for tumours in the anterior parts of the brain is 40 per cent, and of the posterior parts 65 per cent, whilst late recoveries total about 20 per cent for all cases. In some inoperable tumours radiotherapy is capable of relieving such symptoms as vomiting, headache, and convulsions.

The Treatment of Trigeminal Neuralgia.—Adson, of Rochester, Minn., read a paper on this subject, illustrated by a cinematograph film. It is a matter of importance to distinguish true trigeminal neuralgia from other conditions causing unilateral pain—e.g., migraine, glossopharyngeal neuralgia, and sphenopalatine neuralgia. Alcohol injection is regarded as merely palliative, giving relief for a period of about six months. Radical operation, by division of the sensory root of the Gasserian ganglion, is regarded as the standard treatment which should be carried out in every case when the diagnosis is certain, unless age, debility, or intercurrent disease makes it dangerous. The operation is done under combined local and general anæsthesia, the latter being given only during the actual exposure and division of the sensory nerve-root. A vertical incision is made in front of the ear, the temporal muscle is split in the same line, and the bone removed from the middle cranial fossa for a diameter of about 3 cm. The dura is elevated, the middle meningeal artery ligatured, and the outer border of the Gasserian ganglion defined. The motor root, which lies ventral to the sensory and on its mesial side, is avoided by traction on the more superficial sensory root, which is alone divided.

The total number of cases treated had been 839, of which 448 were males, and 391 were females. The average age was 55 years, the youngest being 17 and the oldest 88. The average duration of symptoms was seven and a half years. The different divisions of the nerve were effected alone or in conjunction with other divisions as follows: 1st division, 253 cases (30 per cent); 2nd division, 439 (52 per cent); 3rd division, 551 (65 per cent). In 541 cases the right side was affected, in 285 the left side, and in 13 both sides. Of the 839 cases, 587 were subjected to radical operation, 371 of such operations consisting in simple division of the sensory root.

The number of deaths was 15: hæmorrhage 1, meningitis 3, pneumonia 3, cerebral hæmorrhage 2, pulmonary embolism 2, cardiac failure 2, other conditions, diabetes, nephritis, etc. 2. The complications were: inflammation of the eye 47, including 6 cases of permanent corneal opacity, and 2 in which enucleation was necessary; impairment of hearing 4; temporary facial paralysis 4.

Jacksonian Epilepsy.—Leriche (Strasbourg) made a very interesting communication based on the study of 30 cases of traumatic Jacksonian epilepsy.

His two chief points were : (1) That lesions of the bones and meninges are of very little importance, the real causative condition being a fibrous scar in the cortical substance ; (2) That when it is impossible to define or remove this cerebral scar tissue, much may be done to ameliorate the symptoms by the regulation of intracranial pressure either by intravenous injection of distilled water or by the ingestion of hypertonic solutions.

The Surgery of the Spleen.—The discussion on this question was rendered difficult by the fact that the subject itself was so large and diffuse that it required the presentation of lengthy monographs by the various participants, who, in speaking, could only touch on a few points. The chief contributors were Cotes Llado (Seville), Patel (Paris), Leotta (Bari), Papayoannou (Ghezireh), and Henschen (St. Gall). The last-named presented a monograph of 189 pages, giving an admirable summary of our present knowledge. He also showed a beautiful series of X-ray pictures portraying the injected vessels of the spleen with their connections with those of the stomach and pancreas.

In addition to the ordinary indications for splenectomy there was a general agreement that purpura hæmorrhagica could be cured by this method ; but doubt was thrown on the suggestion that removal of the spleen led to an increase in blood-platelets. Another point of importance mentioned by several speakers was the advisability of being content with ligature of the splenic vessels in those cases demanding splenectomy in which dense adhesions rendered this operation one of exceptional danger.

PROFESSOR ALESSANDRI'S CLINIC IN ROME.

The Policlinico Hospital in Rome is the largest hospital in the city, and the one in which all the clinical teaching of the University takes place. It is about thirty-five years since it was built. On one of the pavilions facing the Via Policlinico is the famous Lister frieze.

There are about 1300 beds, which are divided between what one might call the City Hospital and the University Clinics. The upkeep of the City Hospital falls on the Municipality, that of the Clinics on the Government, but they are both under the same administrative authority.

The City Hospital has 11 divisions, comprising 3 surgical divisions, 3 medical, 1 for nervous and mental diseases, 1 for infectious disease, 1 obstetrical and gynæcological, 1 dermatological, and 1 for ear, nose, and throat cases. These are served by an X-ray department and a pathological department, both being common to all the divisions.

In the City Hospital the general surgical divisions have each 75 beds. These are each under a chief surgeon, who has a first and two second assistants. These assistants can stay on as long as they wish until they get a better post. All the surgical staff are allowed to do private practice.

Each University Clinic is complete in itself. The University Surgical Clinic contains 120 beds. Professor Alessandri is the Professor of Clinical Surgery ; he has one first and two second assistants. The second assistants are appointed for two years, and the first for three years. The posts are whole-time posts, and the appointments being made only by examination are therefore competitive.

Each Clinic is complete with research laboratories, X-ray department, library, museum, and any other special department which may be necessary, such as photographic and cinematographic departments. There is one University Pathological Institute in the Hospital which serves the University Clinics during term time. During the vacation the Director of the Pathological Department of the City Hospital is responsible for the pathological investigations required by the clinics. The surgical divisions of the City Hospital have no research laboratories attached. All the students must do their clinical work in the University Clinic, though they may also attend the practice in the surgical divisions of the City Hospital.

There are about 400 medical students in Rome. The course lasts six years, the last three being spent in clinical work and pathology. All the teaching is done at the University Clinics in the Policlinico; this is the only teaching hospital in Rome. The City Morgue adjoins the hospital, and the instruction in medical jurisprudence is given here. The Public Health instruction is not given in the Hospital. The University Professor of Surgery gives three clinical lectures and operates three times a week. The lectures on systematic surgery are given by the Professor of Surgical Pathology. The lecture rooms are large and well lighted, and the students



FIG. 106.—Professor Alessandri.

are so placed that they can see the patients. The demonstration theatre is complete with lantern and cinematograph fittings.

All the patients admitted to the Policlinico Hospital pay at the rate of 30 lire a day (5s.). If the patient is unable to pay, then the Hospital Authority sends an account to the Municipality; the latter pays, and gets the money from the patient if possible. No patient is allowed to go into the Hospital, except in cases of accident, if he has an income of more than 20,000 lire a year (£160). He must then go into a private clinic.

The three surgical and medical divisions are on duty for emergencies and accidents on successive days. The University Surgical Clinic is never on duty and always on duty. The first assistant of the University Clinic can take any case which comes into the Hospital if he deems it useful for instruction in the Clinic. When the case has been demonstrated it can be sent to the surgical division which happens to be on duty for the day. The

same applies to other cases which may become in any way chronic; in this way there is a continuous change of cases, so that during the clinical course the student sees the greatest number of cases. This is true also of the Out-patient Department. The University Clinic selects for this Department only those cases which are thought to be worth following up. The University Clinic can admit any case solely for teaching purposes, and the Government pays the Hospital Authorities for the maintenance of these patients. The Orthopædic Clinic with 45 beds is run separately from the general Surgical Clinic under a separate professor.

OPERATIONS BY PROFESSOR ALESSANDRI, APRIL 8.

1. SPLENECTOMY FOR ENLARGEMENT OF SPLEEN DUE TO CHRONIC MALARIA.—(*Operation 8.45 to 9.25.*) The splenic tumour had been present a long time; recently it had become more palpable, and it was thought that

a cyst or neoplasm was present. In addition, the tumour was demonstrated on a skiagram taken after the introduction of air into the peritoneal cavity. An incision was made through the left rectus muscle. The tumour was not a cyst, as no fluid could be withdrawn by a syringe, nor was it a neoplasm. It was merely an irregularity on the surface of the spleen. It was decided that splenectomy should be done. There were many adhesions. The pancreas was very adherent and separated with great difficulty. It was necessary to leave a long plug *in situ* to control the oozing from the surface of the diaphragm. The anaesthesia was ether by the open drop method.



FIG. 107.—Professor Alessandri about to operate.

2. HYSTERECTOMY FOR MULTIPLE FIBROIDS.—(*Operation 9.40 to 10.30.*) The anaesthesia was intraspinal by tutocaine and adrenalin given between the 12th dorsal and 1st lumbar vertebra. The patient was an old woman, and immediately after the injection she was placed in a very high Trendelenburg position. The anaesthesia was perfect, and there was no shock.

3. PARTIAL GASTRECTOMY FOR PERFORATING ULCER ON THE LESSER CURVATURE.—(*Operation 10.40 to 11.30.*) The anaesthesia was intraspinal by tutocaine and adrenalin given between the 12th dorsal and the 1st lumbar

spine. The incision was made through the linea alba. There were no adhesions. The union of the jejunum to the stomach was made by the anterior Polya method. The stomach was divided before the first row of sutures was inserted. The appendix was not removed, nor the rest of the abdomen explored.

4. HYDATID CYST OF THE RIGHT LOBE OF THE LIVER.—(*Operation 11.40 to 12.15.*) The pre-operative diagnosis was hypernephroma of the right kidney. The anæsthesia was intraspinal by tutocaine and adrenalin injected between the 12th dorsal and 1st lumbar spine. The cyst was opened and evacuated and drained through the lumbar incision.

5. REMOVAL OF SOLITARY CYST FROM THE LOWER POLE OF THE KIDNEY, AND STONE FROM THE UPPER END OF THE URETER.—(*Operation 12.20 to 1.*) The pre-operative diagnosis was stone in the right ureter and pyonephrosis. The skiagram showed the stone in the upper end of the right ureter. The anæsthesia was intraspinal with tutocaine and adrenalin injected between the 12th dorsal and 1st lumbar spine. The kidney was exposed through a lumbar incision. The lower pole of the right kidney was found to have a large cyst about as big as a grape-fruit. At first it was thought to be a hydronephrosis, but later judged to be a cyst separate from the pelvis of the kidney. The cyst wall was excised, and the stone then removed from the ureter. The ureter was closed with catgut, and the kidney dropped back into position.

The anæsthesia in each case was perfect. It was stated that tutocaine was much preferred to stovaine on account of the action being more certain and the after-effects of headache and vomiting less. There was certainly no clinical sign of shock during the operation or at the end.

*SHORT NOTES OF
RARE OR OBSCURE CASES*

GIANT MECKEL'S DIVERTICULUM (33½ inches long).

BY H. H. MOLL, LEEDS.

THIS case is noteworthy on account of its unusual clinical features during life and the anatomical abnormality found post mortem—namely, a very large diverticulum of the small intestine..

HISTORY.—An infant, 5 months old, was admitted under the care of Dr. Vining for severe attacks of melæna. A first attack, sudden in onset, occurred two days after birth, a second hæmorrhage took place two months afterwards, and a third just before admission. When admitted, the child appeared very blanched, and the blood-count showed a very severe type of secondary anæmia. Repeated small injections of blood taken from the father were given intramuscularly and improved the child's condition, and the patient was duly discharged from the hospital.

The infant was, however, re-admitted two and a half months later for another severe attack of melæna. This time a diagnosis of polypus of the intestine was suggested, and a laparotomy was performed which revealed free fluid in the abdomen and enlarged mesenteric glands. The condition was taken to be tuberculous, and the abdomen was closed. The child died a few days after the operation.

POST-MORTEM EXAMINATION.—On opening the abdomen the peritoneal cavity was found to contain a few ounces of clear, straw-coloured fluid. The lower part of the ileum had a double-barrelled appearance which at first was thought to be due to matting together of two coils of intestine, as seen in tuberculous peritonitis. On closer inspection, however, one of the two coils proved to be a very large diverticulum arising from the ileum two feet above the ileocæcal valve. The diverticulum showed all the layers of the small intestine, and communicated with the main channel of the gut by a large opening about an inch in diameter, lying on the antimesenteric border of the ileum. At the junction of the diverticulum with the ileum were two chronic ulcers which probably had been the cause of bleeding during life.

The diverticulum crossed over the ileum to become attached to its mesenteric border and thus accompanied the gut upwards for 33½ in., terminating blindly. A well-marked stitch-work, very typical of physiological adhesions, bound the diverticulum to the gut, and blood-vessels, branches of the ileocolic artery, were seen coursing across the ileum to supply it. No communication between the two channels, other than the one described, was detected even after the water test; nor did the ileum present any breach of its

muscular coat which might have given rise to a hernial protrusion of the mucous membrane.

Except for a retention cyst, the size of a hen's egg, in the left pleural cavity, all the other organs were normal.

The photograph (*Fig. 108*) shows the diverticulum curled up inside the ileum. A ligature has been tied an inch above the junction of the diverticulum with the gut, and the small intestine has been laid open in order to expose the opening of the diverticulum into it.

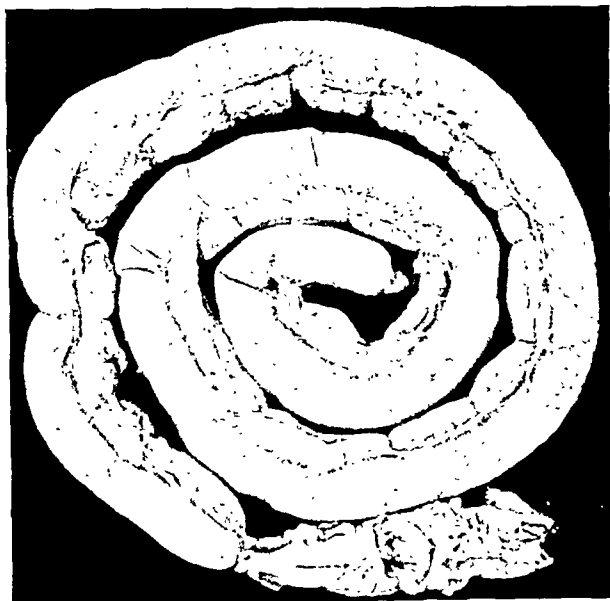


FIG. 108.—The diverticulum curled up inside the ileum.

COMMENTARY.

The diverticulum described above is clearly of congenital origin, but owing to its unusual length some doubt arises as to its being a true Meckel's diverticulum. Although the normal length of a Meckel's diverticulum varies between one and four inches, it may sometimes exist only as a nipple-like protrusion, whilst in other cases it may attain a considerable length. The maximum lengths so far recorded by the particular observers are as follows : Cunningham $5\frac{1}{2}$ in., Lamb 7 in., Rokitsky 10 in.

Pollard described a diverticulum of the small intestine 36 in. long, but did not attempt to classify it. He gave the following description of the specimen : " At a distance of 24 in. from the pylorus the intestine bifurcates. The two segments are similarly supplied with mesentery, so that it is only by tracing them that the true intestine and the diverticulum can be distinguished. The diverticulum after a course of 36 in. reaches the umbilicus, beyond which it originally terminated as a large cul-de-sac in the umbilical

cord. The other segment of the intestine terminates at the ileocaecal valve after a course of 63 in."

The present specimen presents certain features which lead one to think that it is of a true Meckelian type. It occupies the usual site, since it arises

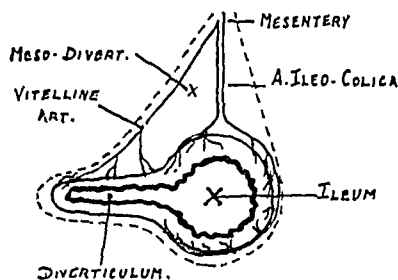


FIG. 109.

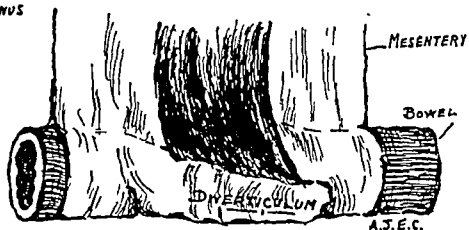
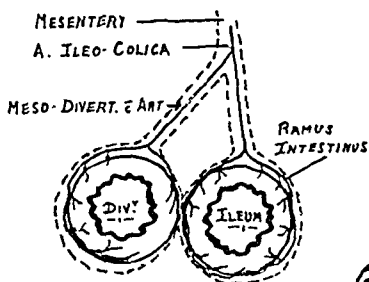
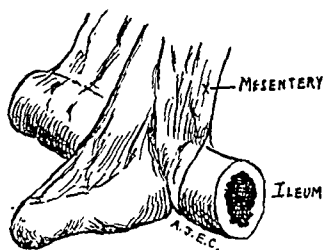


FIG. 110.

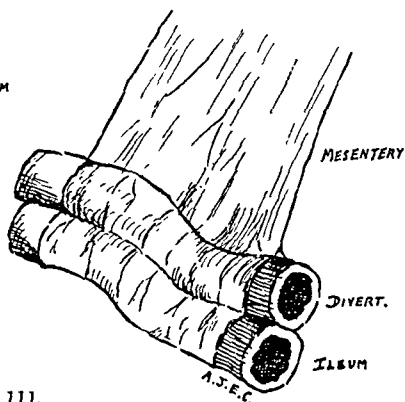
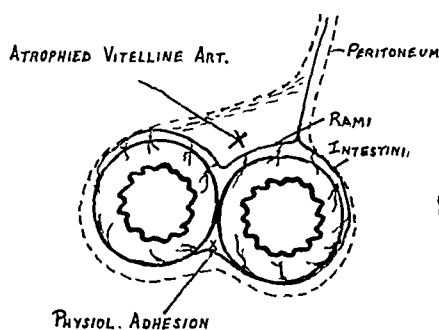


FIG. 111.

FIGS. 109-111.—Probable stages in the development of the diverticulum.

two feet above the ileocaecal valve; it opens into the antimesenteric wall of the intestine, and only later crosses over the gut to become attached to its mesenteric border. The diagrams illustrate how this may have occurred. In the first instance the diverticulum arises from that side of the gut most remote

from the mesentery, and is provided with a mesodiverticulum containing the vitelline artery (*Fig. 109*). Secondly, the vitelline artery undergoes obliteration and shortening, thus drawing the diverticulum alongside the bowel and upwards towards its mesenteric border (*Fig. 110*). Finally, the diverticulum acquires physiological adhesions to the bowel, loses its old vascular supply, and develops a new one from the bowel artery (*Fig. 111*).

Such a mode of development may possibly explain why the diverticulum, which is seen to arise primarily from the antimesenteric border, at a later stage acquired connections with and appears to extend through the layers of the mesentery. This departure from the usual situation of a Meckel's diverticulum, although rare, is not unknown in the literature, and seven cases have been recorded in which the diverticulum lay on the mesenteric border of the bowel from which it sprang. The unusual length of the diverticulum may be also explained by a premature withdrawal of the bowel into the abdomen.

I am indebted to Dr. Vining for kindly allowing me access to the clinical notes, and to Dr. Cave for the drawings.

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ACUTE PERFORATION OF A DUODENAL DIVERTICULUM.

By K. W. MONSARRAT, LIVERPOOL.

A LADY, age 58, felt a 'twinge' of pain to the right of the umbilicus, at 1.45 p.m. on Feb. 7, 1926, fifteen minutes after eating and enjoying her mid-day meal. The pain gradually increased and passed round to the right loin. About two hours after the attack commenced she vomited twice. The pain became very severe, and was continuous. Dr. Riddell, of Blundellsands, saw her about 6 p.m., and I saw her with him at 8 p.m. She then stated that she had had 'indigestion' for many years, the pain coming on about three hours after meals and being relieved by meals. About a fortnight before the present attack she had been kept awake for three nights by sharp attacks of 'flatulence', which gave her discomfort in the epigastrium and back.

At 8 p.m. her pulse-rate was 100, her temperature 96.8° , and her respirations were 24. She was acutely distressed by persistent abdominal pain, entirely to the right of the middle line, for the most part below the right ribs and in the right loin. The abdominal muscles on the right side showed a persistent board-like rigidity, the liver dullness was normal, and the flanks were resonant. Pelvic examination was negative. Diagnosis: acute cholecystitis.

OPERATION.—At 9.30 p.m. the abdomen was opened through the right rectus muscle; about 3 to 4 oz. of clear straw-coloured serum escaped; no

free gas. The gall-bladder was inspected and found normal; the first part of the duodenum showed a chronic ulcer without recent reaction on the anterior wall. The appendix was inspected and found normal. An intense peritoneal injection was noted over the second part of the duodenum, and marked œdema of the subperitoneal tissues to the outer side of the duodenum. Some yellowish exudate was seen through the peritoneum in this region. The peritoneum was incised, and serous fluid escaped containing yellowish flaky material, with fœculent odour. Underlying this exudate a perforation was found in what at first appeared to be the duodenal wall; but on further dissection with the finger a diverticulum was isolated, and the perforation found to be at the apex of this. The diverticulum when delivered was the size of a damson, and possessed a definite stalk about half an inch long. The stalk was ligatured and the stump buried in the duodenal wall. The incision in the parietal peritoneum was not sutured; a cigarette drain was passed down to this incision.

The patient made a smooth recovery.

On opening the diverticulum it was found to contain a yellowish paste-like material with the odour of a *B. coli* culture. On analysis this material proved to be an inspissated mucus, and on culture *B. coli* and 'a non-lactose-fermenter' were isolated. Histologically the diverticulum showed the structure of normal small intestine with villi.

DIVERTICULUM OF THE STOMACH.

By J. W. THOMSON, WAKEFIELD.

H. B., age 45, was admitted to the Wakefield Hospital in November, 1925. His general condition was poor. Thirteen years previously appendicectomy had

been performed, and for eight or nine years he remained in good health. He then began to suffer from pain after food and occasional vomiting, especially after breakfast. His condition gradually became worse. In October, 1924, laparotomy was performed by a right paramedian incision. An adhesion, well marked, stretching from the direction of the cardia to the pylorus, and dragging on the latter, was divided. A diverticulum, as suggested by a skiagram, was not discovered. There was no improvement in the condition of the patient. The case was again referred to the radiologist. (Figs. 112-114.)



FIG. 112.—One hour after barium meal.

OPERATION.—The abdomen was opened by the Navarro-Baudet incision, the subcostal part of this in the first place. Adhesion of the posterior wall of the stomach over a small area close to the œsophagus was discovered. The Navarro-Baudet incision was completed by the transgastric route, and the diverticulum was located on the posterior wall of the stomach about an inch below, and somewhat internal to, the cardiac orifice. The opening was rounded, and just admitted the index finger. Its edges were thin, sharp, and rigid. The finger passed into a shallow, almost circular, barium-coated



FIG. 113.—Four hours after barium meal.

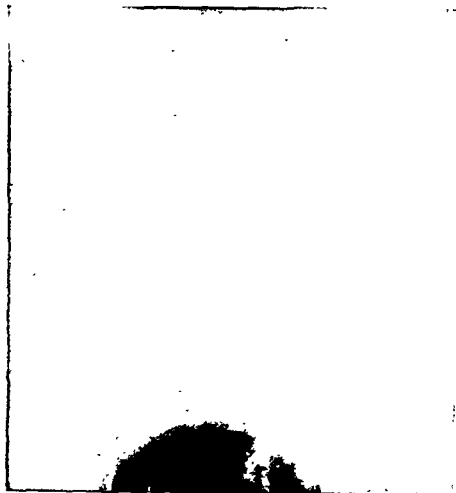


FIG. 114.—Eight hours after barium meal.

cavity, of which the diameter may have been an inch. On further examination, the rigid ring split to the right and to the left.

My intention had been to invert the diverticulum and remove it, but this was totally impracticable. The splitting of the orifice at once suggested the line of treatment, which was to exclude the diverticulum. Two methods of treatment might be considered: (1) Exclusion; (2) Inclusion or inversion.

The pathological report states that there was thinning of all the coats.

AN APPARENT CASE OF PRIMARY EPITHELIOMA OF BONE.

By G. PERCIVAL MILLS, BIRMINGHAM.

On April 16, 1923, W. G., age 27, came under my care at the Royal Orthopædic and Spinal Hospital, Birmingham, for ankylosis of both hips due to old tuberculous disease. During examination it was discovered that he had a swelling of the lower end of the right femur, and he then admitted that he had noticed it for four months, but had attached no importance to it. The swelling was about the size of a small orange, had a well-defined edge, and was firm but not bony hard in consistence. There was no egg-shell crackling,

and the projection was more obvious on the posterior surface of the bone. The inguinal glands were enlarged and hard. The right knee was ankylosed. The skiagram showed absorption of the posterior half of the lower end of the femur, with some small pieces of necrotic bone. There was bony ankylosis of the knee.

On April 24, in view of the uncertainty of the diagnosis, it was decided to remove a portion of the tumour for examination. It had a definite false capsule, was firm on section, and of a yellowish-white colour. It was not unduly vascular, and contained no big veins. The pathologist's report (Professor Haswell Wilson) was : "Basal-celled epithelioma, primary elsewhere". During subsequent discussion Professor Wilson informed me that it was a type of tumour he had frequently seen growing at the bottom of an old bone sinus, and such as had previously been mistaken for a primary epithelial tumour of bone. There was, of course, no sinus present in this case.

On May 18 the patient developed a left-sided pleurisy with effusion, which was naturally regarded with great suspicion. It subsided in a few weeks, however, and he became apparently perfectly well.

As an ordinary clinical examination revealed no signs of a primary growth, I had the patient removed to the General Hospital for a fuller investigation. Mr. Musgrave Woodman kindly examined the nose and throat for me, and reported that there was no tumour in the larynx or in any of the nasal sinuses, while radiological examination of the gastro-intestinal tract showed no abnormality.

On July 21, as no primary growth could be found, I amputated just below the hip-joint and dissected out the enlarged glands from the groin. Convalescence was uneventful, and on Aug. 18 he was discharged from hospital apparently well. The pathologist's report agreed with the previous one. A few months later he began to complain of pain in the right shoulder and the right hip, though there was no clinical evidence of disease in these situations. He was then lost sight of for a few months.

On Nov. 5, 1924, fifteen months after amputation, he was re-admitted. He then had a large swelling involving the outer third of the right clavicle and the adjacent part of the acromion process. The swelling was hard round the edges, but soft and almost fluctuating in the centre. There was also an indefinite swelling in the region of the right iliac bone.

On Nov. 8, 150 mgrm. of radium were inserted into the clavicular swelling for twenty-four hours. The central part of the growth was diffuent, like the contents of a sebaceous cyst, and some of it escaped during the operation. In spite of this the immediate effect was good: the wound healed readily, the tumour shrank to about one-third of its previous size, and the pain in the shoulder was much relieved. On returning home the patient gradually became much weaker, and on Dec. 26, 1924, he was re-admitted. The mass in the right iliac bone was then very obvious, and appeared to involve the whole of the bone. The left side of the chest was dull, with absence of vocal fremitus and vocal resonance, while the breath sounds were almost inaudible. Pain in the right hip and left chest was extreme, and he had to be kept constantly under morphia. He died on Jan. 17, 1925.

POST-MORTEM EXAMINATION.

BY PROFESSOR HASWELL WILSON.

External Appearances.—The body is that of an extremely emaciated young man. The right leg has been amputated through the upper third of the thigh. There is a swelling round the right hip, extending backwards towards the sacrum. The left leg is flexed and rotated inwards from the hip, and shows wasting of extreme degree.

Thorax.—Pericardial sac is occluded by abundant recent fibrinous exudate. There is a nodule of metastatic tumour bulging into the base of the pericardium posteriorly. This is continuous with a swollen mass of infiltrated glands at the root of the left lung.

“Heart weighs 220 grm. The muscle is distinctly atrophied. No lesion is found in the valves or cavities.

“The left pleural cavity is obliterated by old fibrous adhesions. The lung substance is poorly aerated. Its substance is firm and fibrous in consistence, and a considerable degree of bronchiectasis is present. The dilated bronchi contain mucopurulent material, and there are a number of recent abscesses scattered through the lung substance. At the root of the lung the glands are swollen and infiltrated by pale, rather soft tumour tissue. The main bronchus is completely encircled by the mass of enlarged glands, and the growth has fungated into its lumen, which is obstructed. No tumour is found in the lung substance. The right lung is free from adhesions. The upper lobe is emphysematous, and some chronic bronchitis is present. The



FIG. 115.—Low-power view of original tumour.



FIG. 116.—Showing imperfectly formed ‘cell-nests’.

base is congested and œdematous, and early hypostatic pneumonia is present.

Abdomen.—Peritoneum normal. Liver, spleen, and kidneys show no gross abnormality.

"Enlarged infiltrated glands are found in the prevertebral tissues from the sacrum up to the posterior mediastinum. At the brim of the pelvis the enlarged glands merge into a large mass of soft pinkish tumour lying in front of the sacrum and infiltrating the adjacent muscles and nerves. This extends outwards through the right sciatic notch and infiltrates the tissues round the right hip-joint.

"A secondary tumour about the size of a hen's egg is found on the outer end of the right clavicle, where a spontaneous fracture has occurred, and from this there is extension into the surrounding tissues. No lesion is found in the brain or spinal cord.

"With a view to determining the origin of the tumour in the leg, the following regions were carefully searched for a primary growth, with negative result: The whole cutaneous surface of the body (except the

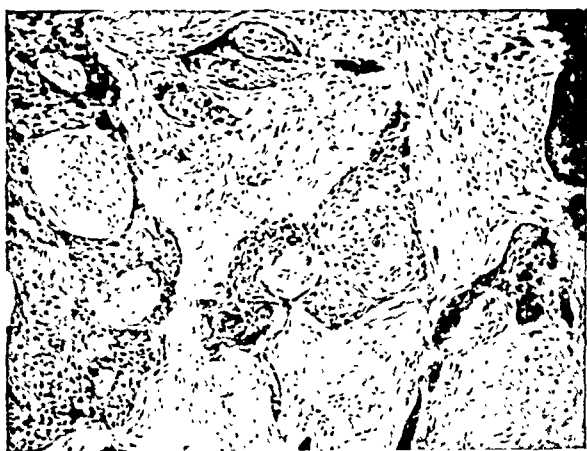


FIG. 117.—Higher magnification of tumour.

amputated leg); the mouth, pharynx, ears, and nasal sinuses; the entire alimentary tract with the related glands, and the anal margin; the respiratory tract and mediastinal tissues; the thyroid and tissues of the neck; the urinary tract, prostate, and testicles; the suprarenals; the central nervous system and ependyma.

"The histological report on the original specimen removed in the Royal Orthopaedic Hospital is as follows:

"This tissue is invaded

by a malignant tumour with the characters of a basilar epithelioma.

"The histological picture closely resembles that of some of the slowly-growing epithelial tumours of the skin. The greater part of the tumour consists of more or less spindle-shaped cells, with comparatively little tendency to keratinization. In places, however, there is definite keratinization, with imperfectly formed cell-nests. The tumour infiltrates widely, and the cells lie in a very dense fibrous stroma.' (Figs. 115, 116, 117.)

"Further sections were made from specimens obtained post mortem. The pelvic mass, the tumours in the bronchial glands, pericardium, and right clavicle all show a structure essentially similar to that of the original section, with varying degrees of keratinization. In all of them the structure is definitely that of a squamous epithelioma, and in none of the sections is there anything to suggest that the tumour has taken origin from anything other than epithelium."

The post-mortem examination was made personally by Professor Haswell Wilson in my presence, and every effort was made to discover a primary

growth. Indeed, it had become almost a point of honour to do so, for Professor Wilson had maintained from the moment of seeing the first section that there must be a primary epithelial growth elsewhere.

There is a tendency for any experience which cuts diametrically across all our lines of thought to be ignored as inexplicable. The rash publisher of a case of primary carcinoma of bone is to the modern orthodox pathologist an infamous heretic, unworthy of credence. Nevertheless, inexplicable facts ought to be recorded, and I have taken the precaution of sheltering myself behind an eminent pathologist (to whom I wish to offer my thanks) in doing so.

UNUSUAL CASE OF TORN INTERNAL MENISCUS OF KNEE.

By F. LANGFORD, BRISTOL.

THE following case well illustrates the great difficulty sometimes met with in finding an abnormal body in a knee-joint, even when it has been clearly demonstrated by X rays. It actually took two surgeons and four separate incisions to find the 'loose' body in this case, the abnormal structure being in itself unusual in that it was a densely calcified portion of internal meniscus still attached.

The patient, J. W. U., age 26, in 1919, while in the Army, fell into a trench and twisted his right knee, which became locked, painful, and swollen. He was treated, and the acute condition subsided in a few days. Ever since that time the knee has been liable to give way frequently, locking and becoming swollen. This came on about once a fortnight, not being caused by any definite movement. When locked, the joint could be freed by an outward blow on the inner side of the patella. The pain was always felt on the outer side of the joint.

In January, 1924, he entered hospital. Extension and flexion were slightly limited and painful, there was abnormal lateral mobility, and pressure on the outer side of the joint was painful.

FIRST OPERATION.—On Jan. 28 the joint was opened by a curved incision on the outer side of the patella, and at the postero-external aspect of the joint a part of the external meniscus was found turned up; this was removed, as it was thought to be the cause of the trouble. The inner side of the joint was then opened by a similar incision, through which it was found that only a few tags remained of the internal meniscus, most of it having apparently disappeared. The wounds were then closed.

The patient states that during the two years since operation his condition has been much worse, the locking, swelling, and pain being more frequent and severe. He was admitted during one of these attacks, the effusion subsiding after a few days in bed. There was slight limitation of movements with abnormal lateral angulation due to laxity of the internal lateral ligament; nothing could be felt in or around the joint. X-ray appearances were exactly as in January, 1924, there appearing to be a loose body towards the back of the knee-joint on the inner side.

child had passed nothing per anum since birth, and was vomiting dark-green fluid. On examination, the abdomen was very distended, especially so on the right side. The anus was small, and admitted a No. 10 Hegar dilator, which was passed for $\frac{3}{4}$ in., and on its withdrawal was not stained with meconium.

It was decided to operate immediately. An anæsthetic was administered, and, on opening the abdominal cavity by a right paramedian incision with

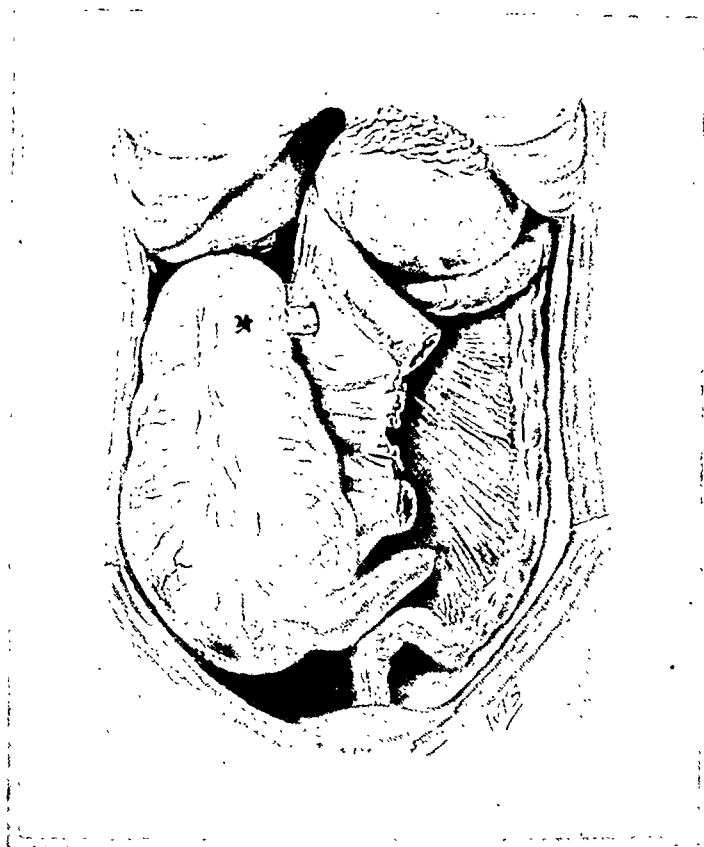


FIG. 119.—Semidiagrammatic drawing made from a sketch drawn immediately after the operation. The distended stomach with its rudimentary omentum is shown turned up on the costal margin to enable the position of the transverse colon on the posterior abdominal wall to be demonstrated. The hepatic flexure is shown displaced to the right so that the constriction of the transverse colon can be seen, where it passes through the mesentery of the small intestine. The opening in the mesentery was oval in shape and flattened in an antero-posterior direction.

its centre at the umbilicus, gas and fluid meconium gushed out, and coils of small intestine, distended with gas, presented. The cæcum was sought for and found just below the liver, not having completely descended into the right iliac fossa, and was greatly distended with gas, as was the appendix, which was blown out like the finger of a glove.

On tracing the ascending colon it was found to dip backwards towards

the vertebral column, and at the hepatic flexure was a rupture of all the coats of the bowel, from which meconium and gas were escaping. On further tracing the colon, it was seen to pass through a small opening about 5 mm. in diameter, in the mesentery of the small intestine, below the superior mesenteric artery. Further examination showed that the continuation of the colon, on the other side of the opening in the mesentery of the small intestine, was much reduced in size, being only about 5 or 6 mm. in diameter, as were the splenic flexure and the descending and pelvic colons.

Into the rupture of the colon was placed a drainage tube, and the opening closed around the tube by a purse-string suture of catgut, and the colon anchored to the anterior abdominal wall by a catgut suture. After sponging the abdominal cavity free from meconium, it was closed except for an opening through which the drainage tube passed.

The patient survived the operation but a short while. No post-mortem was granted.

CONCLUSIONS.

1. That adhesion and fixation of the mesentery occurs in the third month, and is probably completed by the fourth month, as otherwise the colon would not have been occluded in the case described above.

2. That according to Dr. A. Low meconium reaches the rectum at the fifth month, and that the obstruction in the case described must have occurred by the end of the fourth month.

3. That many unusual positions of the small and large bowel found during operations on adults are due to defective or abnormal rotation of the mid-gut at the third or fourth month of embryonic life.

In conclusion, I wish to acknowledge my indebtedness to Dr. T. D. Manning for providing me with the case for operation; to Sir James Berry for helpful criticism; to Sir Arthur Keith for kindly advice; to Mr. Ralph Coyte for his kindness in correcting the proofs; and to Mr. Thornton Shiells for his drawing of the case from a sketch made by myself immediately after the operation (*Fig. 118*).

Readers of the *BRITISH JOURNAL OF SURGERY* will remember that the whole subject of anomalies of intestinal rotation, with a most complete bibliography, bringing the subject up to date, was most admirably described and illustrated by Mr. Norman M. Dott in the *Journal* for October, 1923 (vol. xi). One of the illustrations represents a condition almost identical to that shown in the drawing of my case, which I may add was made before I had my attention drawn to this article. I wish to record my thanks to Mr. Dott for the invaluable help I derived from his paper in forming a correct interpretation of the condition found in the case I have described.

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JEJUNOGASTRIC INTUSSUSCEPTION.

By HARRY DARLING, SYDNEY, N.S.W.

DURING the last two years three cases of jejunogastric intussusception following gastrojejunostomy have been recorded, and recently one such case came under my care at the Coast Hospital.

A male labourer, age 55, who had had gastrojejunostomy performed at another hospital five years previously for 'gastric ulcer', was admitted into the Coast Hospital suffering from 'intestinal obstruction'. Following an attack of diarrhoea (of eighteen hours' duration) he was suddenly seized, forty hours before admission, with severe cramping pains in the epigastrium, associated with vomiting, first of food and bile, and later of blood. The most severe pain came on in spasms, but it also had been continuous up to the time of his admission. The vomiting was frequent, and consisted of dark-coloured liquid blood with an extremely foul odour. The bowels had moved twenty-seven hours previously, but since then there had been inability to pass either flatus or fæces.

EXAMINATION.—The facial aspect denoted that the patient was extremely ill. His temperature was 97.6° , his pulse 120, and his respirations were 36. The extremities were cold, and the skin was clammy. The tongue was very dry and heavily coated, and the breath most offensive. The abdomen was neither distended nor rigid, but the respiratory movements were considerably restricted, and in the left hypochondrium was seen a swelling which appeared to be a dilated and distended stomach. This swelling was due to an extremely tender, indefinite, elongated mass, tympanitic to percussion, and about the size of a fist, which could be distinctly felt above and to the left of the umbilicus.

OPERATION.—The abdomen was opened and the stomach was found to contain a large sausage-shaped tumour. On turning up the colon the origin of an enormously distended jejunum was soon identified, running vertically upwards from the duodenojejunal flexure through a rent in the transverse mesocolon to the stoma in the stomach, to enable it to become continuous with the sausage-shaped mass in the viscus. Lying posterior to this short segment of distended bowel was found the collapsed efferent loop.

The intussusception was reduced with great difficulty by a combination of squeezing and traction, and it was then found that a posterior gastrojejunostomy had been performed, with a loop $2\frac{3}{4}$ feet long, and the proximal jejunal loop had intussuscepted for some $2\frac{1}{2}$ feet into the stomach through the gastrojejunostomy opening. The reduced gut was enormously distended, being three or four times its normal size, having its walls very œdematous, and showing areas of hæmorrhage. There was lack of pulsation in the vessels supplying the upper 4 in. of the loop. Owing to the man's shocked condition resection was out of the question, so entero-anastomosis was performed with a Murphy's button, 4 in. below the stoma. The patient grew worse in spite of stimulants, radiant heat, and saline infusion, and died seven and a half hours after the termination of the operation. The stoma in this case was situated on the posterior wall of the stomach, about $2\frac{1}{2}$ in. above the greater curvature, was horizontal in direction, and admitted two fingers.

REVIEWS AND NOTICES OF BOOKS.

Operative Cystoscopy. By E. CANNY RYALL, F.R.C.S., Founder of and Senior Surgeon to All Saints' Hospital for Genito-urinary Diseases, London. Folio. Pp. 47, with 115 plates containing 670 original illustrations, of which 528 are coloured. 1925. London: Henry Kimpton. 70s. net.

THIS monumental work is the result of many years of labour by a surgeon who is an enthusiast in operative cystoscopy. After looking through it we feel a doubt as to which to admire more: the ingenuity of the author and his extraordinary industry or the beautiful illustrations by Mr. Thornton Shiells; between them they have produced a volume which is quite unique in English surgery.

The book consists of 47 pages of description by the author, and this is followed by 115 plates: the latter show cystoscopic pictures, X-ray appearances, opaque bougies, etc., and numerous instruments; some very well-drawn diagrams of the various intravesical procedures are also included.

In the preliminary letterpress the author describes his technique in detail, and lays great emphasis on the importance of the use of local anaesthesia: for this purpose he employs $\frac{1}{4}$ fluid drachms of $\frac{1}{2}$ per cent cocaine hydrochlorate; he claims that the injection of this into the urethra by his method has never produced any toxic symptoms, though it has been used in many thousands of cases, and that it is followed by good anaesthesia of the base of the bladder as well as of the whole urethra.

A large section is devoted to Ryall's own treatment of calculus impacted in the ureter: to entice the stone from the ureter into the bladder, he makes use of a large number of devices: the passage of special conical bougies, of expanding dilators, and of laminaria tents, dividing the ureteral orifice with scissors or with a diathermy blade. In almost every case the instruments employed have been invented by the author; one of the most attractive of these is a small ureteral lamp which he passes to assist the finding of the ureter when it is cut down on in the ordinary way. If we were to make a criticism, it would be that both the operator and the patient must have been very long-suffering, as, in some of these cases, the treatment extended over many weeks and necessitated a great many cystoscopies. In one exciting case, in which a double ureterocele was treated by diathermy, a partial anuria followed, and was cured by plunging a cystoscopic knife into a distended cyst.

The author's treatment of stone in the bladder is equally striking; he crushes them with his special cystoscopic lithotrite, and claims that it is a great advantage to be able to see what is actually happening; this is specially so if the calculus is in a sacculus; even his method of evacuation of the fragment is original, for he uses a cystoscopic evacuator by which he can see the position of the fragments and whether any have been left behind. His technique for the removal of foreign bodies from the bladder is most ingenious and well illustrated.

There are some excellent plates showing the method of treating bladder growths by diathermy; the author has again invented his own instruments; perhaps the most striking point is the really extraordinary absence of scarring after this operation. A good deal of stress is laid on the importance of extreme care in the employment of diathermy on those parts of the bladder which are covered by peritoneum.

The last section deals with those various conditions of the prostate which are amenable to intravesical treatment. Certainly the most fascinating and original part of the book, and possibly the most valuable, is that which concerns the diagnosis and treatment of the numerous conditions which may lead to a persistent suprapubic fistula after prostatectomy; they are very various, and Ryall's way of dealing with them is highly ingenious and effective.

It would seem an ungrateful task to point out some defects in such an excellent work ; and if we do so, it is with the hope that the author will see his way to have them corrected in future editions. Some of them are obviously printer's errata : thus on page 2, *Plate VIII, Fig. 1*, should be *Plate I, Fig. 1* ; later in the book, the text explaining *Plate XCI* appears opposite *Plate XC* and the text of *Plate XCII* is opposite *Plate LXXXIX*. On page 16, for "a contracted and irritant bladder" we should surely read "a contracted and irritable bladder."

The descriptions of the plates are all given in English, French, and German ; it is an astonishing fact that the author, so indefatigable and meticulous in his cystoscopic work, should have allowed so many mistakes to creep into the French translation ; accents, genders, grammar, all are wrong. Macaulay's famous student could have detected hundreds of errors ; to give an example, the "dragged-in appearance of the right orifice" is translated as "l'aspect dragué de l'orifice droit" ; the French have certainly adopted some English words which look very queer, for instance the use of the word 'stopper' in the sense of stopping a steam boat, but we think they have not yet incorporated the word 'drag'—at any rate, in that sense. We apologize to Mr. Canny Ryall for these few captious remarks, but we think that such very crude French might produce an unfortunate impression on the other side of the channel.

We sincerely congratulate the author and the artist on their *opus magnum*, and we hope that the former will long continue to work at this subject and produce new instruments and show us how to use them ; indeed, we look forward with confidence to the time when he will produce a ureteral lamp which will show us a papilloma or an angioma of the kidney pelvis, and also a method of arresting the bleeding from such a source without the deplorable necessity of bisecting an otherwise healthy kidney, with the inevitable result of a gross diminution of its functional capacity, and, frequently, its later removal for secondary hæmorrhage.

La Curiethérapie des Cancers. By SIMONE LABORDE, Chef au Laboratoire de Radiologie au Centre anticancéreux de Villejuif. Medium 8vo. Pp. 334, with 43 illustrations. 1925. Paris: Masson et Cie. Fr. 27.

THE progress made in radium therapy is admirably discussed in this book of Dr. Laborde. The author follows the development of technique from the earlier days, when treatment was more or less empirical, to the present, when in spite of gaps in our knowledge the sure foundation of scientific accuracy is slowly being reached.

One cannot but be impressed by the masterly summary of data given in the preface. In this short section a comparison is made between the action of X rays and radium, and attention is drawn to the fundamental difference between the technique of these two agents. In radium therapy it is suggested that, if a continuous action by the radiations over a long time period is used, the effect on the growth and the normal tissues is likely to be more beneficial ; this is in accordance with modern views, and is substantiated by experimental work on all growths in vivo and in vitro. The action of X rays is contrasted in so far as it must necessarily be intermittent ; if used continuously the duration of the exposure is necessarily much shorter than when radium is employed.

The important point is also made that the destructive action on the blood-cells and other normal tissues is much less when radium is used than it is with X rays. The important question of how much of the effect may be due to the indirect actions of the rays is, however, only tentatively suggested, and it has yet to be proved that radium in this respect is equal to X rays, which by virtue of the greater certainty and the wider distribution of the rays may exercise a more decided action in the direction of indirect effects. The important indications given by the results of recent work with radium rather favour the use of X rays in a manner similar as nearly as possible to the radium technique.

A brief section indicates that the probability of using both agents has not been overlooked. The importance of the biological reaction is made clear, and the author wisely makes the following statement : "Thus it is possible that our ideas relating

to the action of rays on cancers, an action attributed at present solely to a local effect, will one day be changed." In fact that conclusion has already been reached by a number of observers, and much research is now being directed to the elucidation of the indirect effects of radiations upon the tissues as a whole. The fact is apparent that both actions contribute to the general effect.

The important question of minimization is also given due prominence throughout this work. It is pleasing at the end of this excellent summary to see a reference to the permanency of the work of Dominici, one of the earliest workers, and to the far-sighted view he took, in those early days, of the action of radiations upon tissues.

A notable part of the work deals with 'units', and a record of the development of the unit is given. In the beginning of radium therapy the method was haphazard, largely because of the instability of the applicators; the physical laws were understood from the beginning, but the preparation and scaling of the applicators left much to be desired, while impurities in the compounds of radium also contributed to inaccuracy. The unit of radium is the gramme of radium element, but as this represents a large quantity it is more convenient to use the milligramme of radium element present in any applicator as the unit. The unit of emanation is the curie—that is, the quantity of emanation in equilibrium with one gramme of radium element; as this is also relatively a large quantity, it has become customary to refer to the millicurie as the standard of the emanation.

The clinical forms of cancer are described, and the diagnosis is entered into fully. The types of carcinoma are compared as regards malignancy. Regarding biopsy, or the removal of a small piece of a growth for pathological examination, reference is made to its importance in establishing an accurate diagnosis. The need for expert manipulation in special regions is emphasized. The author evidently does not share the fear so often expressed by some workers of opening up channels of dissemination by this procedure. The value of radiography as a diagnostic aid is also alluded to, and attention is called to the difficulty of interpretation of radiographic plates. Modern methods of radiographic technique, such as inflation of the ventricles of the brain in the localization of cerebral tumours, are appreciated.

A brief reference is made to the blood changes in cancer. These are marked, but up to the present the author does not think that there are any changes which are specific. Chemical changes, on the contrary, appear to be more constant; glucose is often found in excess, and a diminution in the total albumins is observed. These, however, though interesting from the biological side in cancer, do not carry with them any diagnostic points of practical interest.

An important matter is discussed under the heading 'latent period'. This has reference to the action of radiations generally, and is of great value in practical work. The length of this period depends upon the nature of the ray, the dose employed, and the organism irradiated, and also on certain biological factors, among which the cell activity holds a notable place.

A careful consideration is given to the technique of radium therapy; this is described fully in regard to radium salts and emanation, while the actual measurement of the rays is dealt with in a scientific way. The method of application is also handled from the essentially practical point of view.

The remaining chapters of the book are devoted to a regional consideration of the various forms of malignant disease; these sections are abundantly illustrated by half-tone blocks showing cases before and after treatment. A number of striking cases are shown, which go to prove that radium in the hands of an expert is capable of causing the disappearance of a number of obviously malignant tumours.

The book details a careful and scientific survey of the radium therapy of malignant tumours. It is the work of a most thorough and careful investigator, who from the beginning to the end shows a mastery of the subject combined with a moderation of view which is commendable. It is obviously considered from the standpoint of a scientist who is at the same time a physician familiar with the clinical aspects of the disease with which he has to deal. Readers will find within the pages of this work much that is useful, and as a whole it can be relied upon to give precise information on a large number of difficult points in practice. The author in her

preface states that the object of the book is to answer the numerous questions asking for a definition of the indications for radium therapy and a description of the technique. She has succeeded admirably in giving just the information required by those not conversant with the matter, and she is to be congratulated on the excellent manner in which she has completed her task.

The Royal College of Surgeons of Edinburgh: Historical Notes from 1505 to 1905. By CLARENDON HYDE CRESWELL, F.S.A. (Scot.), late Officer and Sub-Librarian of the College. 8vo. Pp. 315 + xv, illustrated. Privately printed for the College by Oliver & Boyd, Edinburgh, Tweeddale Court; London, 33, Paternoster Row. 10s. net.

MR. C. H. CRESWELL was Officer and Sub-Librarian of the Royal College of Surgeons of Edinburgh from 1899 until 1918. He died on active service, leaving the materials from which the present volume is compiled. The President's Council, in whose hands the manuscript was left, have done well in causing it to be edited and published, though the names of those responsible for seeing it through the press are only indicated by initials. The volume is wisely entitled *Historical Notes* rather than a history of the College. It provides the *Quellen* from which a future historian will draw much of his material, elaborating what is here set down, collating it with what is known of the sister Colleges, and amplifying it with a variety of interesting details.

The development of the Edinburgh and English Colleges of Surgeons has proceeded along somewhat similar lines. The first notice of the Edinburgh College is in 1504, when it appears as a guild with an altar dedicated to St. Bride in the Kirk of St. Giles. The patron saint of the craft was St. Mungo, and Master David Lauder was the Chaplain. The future historian will have to work out the earlier history from 1210 to 1505. The religious guild was already a trade guild, and, like the other trade guilds in Edinburgh, was dominated by the Town Council, in whose election the surgeons had no vote. Being barber surgeons, they were tradesmen, and as tradesmen they had a monopoly for the making and selling of aqua vitæ. There is some evidence of a few of the members of the guild acting solely as surgeons. The future historian will have to differentiate these men and discover the exact position they held. It is probable that they were like the sworn surgeons or the town surgeons of the free cities in Germany. In process of time—that is to say, about 1657—the trades of barber and surgeon gradually drifted apart without any formal separation such as happened in England in 1745. The barbers remained as barbers, the surgeons allied themselves to the apothecaries and became surgeon apothecaries. The compound title was dropped and the surgeon apothecaries became surgeons. The Incorporation of Surgeons was called a College in 1686 and became The Royal College of Surgeons of the City of Edinburgh in 1778.

The book is well printed and the eight illustrations are well reproduced. The Latin on pages 163 and 194 is such as would "break old Priscian's head". It should be made congruous in the next edition.

Traumatic Injuries of the Carpus, including Colles's Fracture. By KELLOGG SPEED, S.B., M.D., F.A.C.S., Assistant Professor of Clinical Surgery, Rush Medical College of the University of Chicago, etc. Imperial 8vo. Pp. 197 + xvi, illustrated. 1923. London: D. Appleton & Co. 21s. net.

THIS is an admirable book. The English reader is liable at first to be put off by the transatlantic phraseology and the use of the new anatomical nomenclature, which in the case of the wrist-joint differs very greatly from the old. When, however, these little difficulties have been mastered, we find that there is here a very thorough and extensive monograph on wrist injuries of all sorts.

The first chapters are given up to Colles's fracture and its varieties. Perhaps the most important statement found here is: "Practically all of the Colles's fractures which lead to permanent disability have resulted from improper reduction, coupled with one other important factor which seems to be a common error among practitioners—prolonged splinting." An excellent description of methods of reduction is given, and a very careful consideration of the criteria of proper replacements. The section on operative procedures is not so good. The details of this very difficult

exposure are omitted, and no mention is made of whether a wedge should be removed or a curved osteotomy carried out. Two statements which may be doubted are that in separation of the epiphysis the bone gives way through the cartilage (it is generally considered to give way on the diaphysial side of the cartilage), and that in a chauffeur's fracture the fragments are almost never comminuted (the general experience would seem to be that comminution is more frequent in a severe chauffeur's fracture than in a true Colles's fracture).

The second part of the book deals with injuries of the carpal bones in very great detail. A nomenclature is devised which is complicated, but at the same time, when once mastered, does give a true description of the anatomical lesion present. Thus a fracture of the navicular with dorsal dislocation of the second row of the carpus together with the distal half of the navicular and the triangular is named a 'trans-navicular-perilunar dorsal dislocation of the wrist'. The mechanism of production of all the carpal injuries is considered in detail, and there are ample illustrations by X-ray photographs and diagrams which will assist in unravelling the complexity of many of these injuries. The pathological changes occurring in damaged carpal bones are also described, as well as the methods of approach for operative procedures when removal of some of the bones is necessary.

One point which might receive further attention is the prognosis of these carpal injuries, particularly after the removal of individual bones or portions of bones. The statement is made that the writer has removed 20 lunates, 6 combinations of lunate and navicular, and 11 naviculars after fracture, and all with satisfactory functional return. A little more detail as to the time taken to get this restoration of function and the actual range of mobility remaining in the wrist would be of great assistance to those who meet with comparatively few cases of carpal injury and desire guidance as to the advisability of operative procedures on individual cases.

The Treatment of Fractures and Dislocations in General Practice. By C. MAX PAGE, D.S.O., M.S., Senior Surgeon to Out-patients, St. Thomas's Hospital, etc.; and W. ROWLEY BRISTOW, M.B., B.S., F.R.C.S., Surgeon to the Orthopædic Department, St. Thomas's Hospital. Second edition. Demy 8vo. Pp. 279 + xiii, illustrated. 1925. London: Humphrey Milford. 12s. 6d. net.

The authors have certainly enhanced the utility of the new edition by including some common dislocations, but this has perhaps made more obvious a want of balance in the book to which we referred in our former review. Fractures of the skull and mandible can scarcely be of less importance to general practitioners than those of the arm; yet the space accorded to the former is little more than that devoted to fractures round the wrist, and the treatment of intracranial hæmorrhage is unworthy of a manual for first aid.

We do not consider that the chapter on operative treatment is up to date: it is not our experience that "the plate is liable to loosen after two or three months" *unless it has been infected at the operation*; and the figure showing the screws pulling out and the plate loose depicts a condition which must surely be of extreme rarity in any clinic where reasonable cleanliness is observed.

The figure of a fractured humerus treated with the elbow extended in a Thomas should be replaced, for even though it is borrowed from a high orthopædic authority it lays stress on a position which should only be permitted when good alinement can be obtained in that position only.

We would like to see greater stress laid on the value of immediate X rays in two planes after reduction of fractures; this particularly applies to Pott's fracture, but nothing is said in this connection. Surely Mr. Page does not confine his operations for Pott's fracture to those in which vicious union has occurred; if so it is not surprising that he has not a high regard for operative treatment. This is personal and unimportant in comparison with the author's failure to seize a grand opportunity of impressing on the practitioner that the best way to treat mal-union is to prevent it.

There is much that is sound and useful in this book, and we have often referred to it for guidance; it could be improved if the authors would write more fully on common conditions of which they have experience rather than include many rare injuries which they do not happen to have come across.

Die Chirurgie: A System of Surgery. Edited by Professor KIRSCHNER (Königsberg), and Professor O. NORDMANN (Berlin).† To be completed in six volumes. Imperial 8vo. 1926. Berlin: Urban & Schwarzenberg. Fasc. 6, Vol. IV, pp. 358, with 167 illustrations in the text and 23 coloured plates, M. 21; Fasc. 7, Vol. I, pp. 277, with 288 illustrations in the text and 7 coloured plates. M. 17.

FASCICULUS 6 deals with the surgery of the mouth and that of the larynx and trachea. The former part is by Professor Brüning (Berlin). It gives a very complete account of the diseases of this region, including rare affections, e.g., trichinosis and leprosy, as well as the common condition of malignant disease. The older classical operations for the latter are well described and illustrated, but the details of lymphatic extirpation are very meagre, and block-dissection is not mentioned. Also the prognosis after operations for epithelioma of the tongue is not discussed, and various operations of removal of the floor of the mouth with a part of the lower jaw are described without any warning that such operations seldom prolong life sufficiently to make them worth while. The chapters dealing with the salivary glands are very good and clear, the diagrams showing the deep relations of the parotid being very useful.

The section on the larynx and trachea is by Professor Soerensen (Berlin). It is generously illustrated both in black and white and in colour. The fine series of coloured drawings showing extirpation of the larynx are very realistic, but from an artistic point of view are decidedly crude. A useful and detailed account of the methods of local anaesthesia as applied to neck operations is given.

The first part of Fasciculus 7 is by Dr. Gohrbandt, and consists in an excellent description of the art of surgical sewing, with a great number of clear diagrams giving knots and stitches of every kind, and special methods of joining or mending blood-vessels or viscera. There follow two sections on pyogenic and specific infections, by Dr. Buzello and by Professor Eden with Dr. Drevermann respectively. The chapter on pyogenic infection is well arranged, and illustrated with typical bacteriological and clinical figures, including coloured figures of cases of gas gangrene.

Cancer of the Rectum. By W. ERNEST MILES, F.R.C.S., Senior Surgeon to the Cancer Hospital, etc. Demy 8vo. Pp. 72 + viii, illustrated. 1926. London: Harrison & Sons Ltd. 7s. 6d. net.

THIS little volume contains the Lettsomian Lectures delivered before the Medical Society of London in 1923. The text of the lectures has not been altered, nor have any additions been made to it. The views of Mr. Miles upon cancer of the rectum are now well known. They are based upon two fundamental conceptions: (1) That a knowledge of the pathological state and tendencies of a malignant growth should be known, and these include a clear understanding of the anatomy of the lymphatic system of the parts involved; (2) That the widest possible operation, based upon that knowledge, should be performed on all cases unless the contrary indications outweigh this necessity. These two conceptions are studied with the utmost care, and an experience unsurpassed in this country is brought to bear upon their elucidation. The operation practised by Mr. Miles is fully described and well illustrated.

We do not need to examine in detail the wealth of material compressed in this small volume. It is the best exposition of the subject with which we are acquainted. If observation and a logical deduction from the facts gleaned by careful investigation are to decide the question of the operation to be practised in this grave disease, the methods of Mr. Miles must receive our favourable verdict. Unhappily the reticence of cancer of the rectum in many cases, the very late stage of the disease found when the patient is first examined, and the cachexia which has had time to develop, stand often in the way of our ideals. But Mr. Miles's work is steadily helping us all to a better realization of the possibilities of surgery even in advanced cases. We consider that Mr. Miles has done much for the credit of British surgery, not only by his careful and long-continued observations, but by the perfecting of an operation which in his hands is a model of design and exquisite accomplishment.

The Diagnosis, Treatment, and End-results of Tuberculous Disease of the Hip-joint. By GEORGE PERKINS, M.Ch. Oxon., F.R.C.S., Assistant Surgeon to the Royal National Orthopaedic Hospital, etc. Demy 8vo. Pp. 118 + x, with 32 illustrations. 1926. London: Humphrey Milford. 6s. net.

THIS small book is the first monograph for which the 'Robert Jones' prize and medal has been given. It represents a clear account of certain phases of hip disease and certain methods of treatment, but is too brief to be of great value. The author strongly advocates the advantages of a special form of fixation frame; he lays great stress on traction in the treatment of the disease: and he considers that active operative methods may have some place both in the treatment of tuberculous abscesses and of early stages in the diseased joint. The most valuable part of the book is a description of the late results of treatment in fifty cases which have been followed up for some years. The X-ray illustrations are very clear and add great value to the text.

Contribution à l'Etude des Paraplégies Pottiques. By Mme. le Docteur SORREL-DEJERINE, ancien Interne des Hôpitaux de Paris. Royal 8vo. Pp. 402, with 97 illustrations. 1926. Paris: Masson et Cie. Fr. 40.

THE author of this volume is Madame Sorrel-Dejerine, wife of Dr. E. Sorrel, Director of the Hôpital Maritime de Berck, and daughter of the late Professor Dejerine: there is an introductory preface by Dr. André-Thomas. The expectations aroused by work with such an ancestry are amply fulfilled. The first 230 pages are devoted to a study of 44 cases of Pott's disease with paraplegia, and the clinical details of these cases are fully described in the second part of the book. There are, in addition, eight pages of references, giving a full and very useful bibliography.

An interesting historical survey of the subject is followed by chapters discussing the mechanism of compression and the morbid anatomy both of the spinal column and of the cord. The study of the changes found in the cerebrospinal fluid is of special interest. Eighteen cases were examined by the lipiodol method of Sicard, and as a result of this the writer claims to be able to distinguish between cases in which the compression is due to abscess and those in which it is due to pachymeningitis. In some of the cured cases the lipiodol was still held up after a long interval, and this she attributes, not to adhesions as one would expect, but to the actual deformity of the spinal canal, since a similar blockage is found in some cases of severe deformity in which no cord symptoms have ever occurred.

With regard to treatment, Madame Sorrel-Dejerine insists that complete fixation in a recumbent position is essential, and unhesitatingly condemns the 'ambulatory' treatment with spinal jackets. Operative treatment is also condemned as unnecessary and ineffective, and indeed her experience in these 44 cases is so good as amply to justify the attitude which she adopts in this respect.

Among 35 of the cases treated at Berck and followed to a termination, 24 were completely cured in from eighteen months to two years, whilst in 8 the symptoms remained stationary, and 3 patients died. It is somewhat surprising to note that the writer finds no difference in prognosis between adults and children, and believes that age is not a factor of importance, a conclusion which is not in accordance with the usual experience in England.

Gynecologic Urology. By LYNN LYLE FULKERSON, A.B., M.D., F.A.C.S., Assistant Professor of Gynecology, New York Post-Graduate Medical School, etc. Royal 8vo. Pp. 247 + xiv, with 166 illustrations, including 86 original and 14 colour plates. 1925. London: William Heinemann (Medical Books) Ltd. 27s. 6d. net.

THE author states, in his preface, that "this book is devoted to the technique of endoscopy and cystoscopy in the female, and the diagnosis and treatment of the commoner diseases of the urological tract. The technique for the most usual operations on the kidneys, ureters, bladder, and urethra is given. While many works on male genito-urinary diseases have been written, there is no small volume that presents the essentials of gynecologic urology in a form that should enable students to quickly acquire a working knowledge of the subject."

We cannot express any great enthusiasm for this book. To begin with the preface, we think it is open to argument whether it is desirable that students should *quickly* acquire a working knowledge of such a subject; however, for the sake of those students who like their knowledge in tabloid form, we may say that there is a great deal of information contained in this book of 227 pages, about one-third of which are taken up by the illustrations.

Unfortunately the information has not, we think, been thoroughly digested, and there are many inaccuracies. To give some examples: it is stated that with polycystic kidney the urine is negative unless hæmaturia is present; from our own experience we should have stated that the urine is invariably of low specific gravity and contains a trace of albumin. Again, in a very short sketch of the embryology of the kidney and ureter, the author states that the ureter develops from the so-called pronephros, the kidney from the mesonephros.

When reading *American books*, the average *English surgeon* expects some curious spelling, but the author's spelling of 'stranguary' is surely very unusual; some may mercifully be imputed to the printer, such as the 'vestibulum pundendi' and 'longitudinal folbs', also a 'stereopticon roentenogram'.

The illustrations which have been borrowed from Kelly and Judd are beautifully reproduced, but the original ones are poor and difficult to decipher.

We consider that the idea of writing a book on urology which will appeal particularly to the gynæcologist is quite a sound one, but we suggest that the author wrote it hurriedly; how else can one explain his laying himself open to the mocking remarks of the flippant when he states that for the sterilization of catheters 'a sterile nurse' should be provided?

Thérapeutique chirurgicale. By P. LECÈNE (Paris) and R. LERICHE (Strasbourg). Vol. III (Abdomen et Organes génito-urinaires). Vols. I and II in the press. Royal 8vo. Pp. 646. 1926. Paris: Masson et Cie. Unbound, Fr. 50; bound, Fr. 60.

"We believe," say the authors, "that there exist certain therapeutic principles, that is to say, rules of practice based on experience, which have a general application in a group of individual cases of which it is of value to set out the significance and the importance."

Surgery is composed of three essential parts: (1) The indications for surgical treatment; (2) The realization of these indications; and (3) The results of the surgical act.

In this book the authors touch but lightly on surgical technique, but pay much attention to the indications for surgery from the standpoint of both the physician and surgeon, and make a critical study of the results, both the immediate and the end-results. In other words, the object of the book is to discuss and ascertain the true curative value of surgical intervention. This, though very laudable, is an ambitious objective, and in our opinion it has been carried out with a considerable measure of success, which should be improved on in later editions. It appears to be the honest opinion of two surgeons of great ability and tried experience, and we compliment them on their endeavour.

A Descriptive Atlas of Visceral Radiograms. By A. P. BERTWISTLE, M.B., Ch.B., F.R.C.S. Ed.; and E. W. H. SHENTON, M.R.C.S., L.R.C.P., late Senior Surgical Radiographer, Guy's Hospital. 4to. Pp. 250 + xx, with 330 illustrations. 1926. London: Henry Kimpton. 21s. net.

THIS volume should prove useful to the busy general practitioner who wants to bring his knowledge up to date in the subjects dealt with. We think for students the detailed explanatory notes are not full enough, and cannot compare with a text-book such as that by Knox. The radiographs are excellently reproduced and are a credit to the publishers. It might perhaps have been better to thank each contributor of the radiographs in the preface only, and not to have placed the name of the radiographer under each individual radiograph.

Thoracic Surgery. The Surgical Treatment of Thoracic Diseases. By HOWARD LILIENTHAL, M.D., F.A.C.S., Consulting Surgeon to Mount Sinai and Bellevue Hospitals; Professor of Clinical Surgery, Cornell University Medical College, etc. Two volumes. Royal 8vo. 1925. Pp. 1294 (with 904 illustrations, 13 in colours). Philadelphia and London: W. B. Saunders Co. 90s. net per set.

THIS is a publication of first importance, and may be described as the greatest existing work on thoracic surgery in the English language. Its only rival is Sauerbruch's monumental work *Chirurgie der Brustorgane*, the second volume of which was issued last year. Lilienthal's book does not quite equal this work in size, minuteness of detail, or in illustrations, but it has the great advantage for the English-speaking people that it is easily understood.

The subject presented is treated in a very comprehensive manner, starting with the physiology and anatomy of the chest and its viscera, and then passing on to a study of diseases and injuries of special parts. The book is well printed in good type; the illustrations are good and easily understood, and we can confidently recommend the work to anyone interested in thoracic surgery.

Allgemeine und spezielle Chirurgie des Kopfes, einschliesslich Operationslehre. By EDUARD BORCHERS, Professor of Surgery, University of Tübingen. Royal 8vo. Pp. 382, with 326 illustrations. 1926. Berlin: Julius Springer. 54 Reichsmarks.

THE plan of this book is to give an account of the surgery of the head—not only of the brain, but of all the structures entering into the formation of the head. It is therefore a text-book of the general and special surgery of the most important affections of the head, considered on an anatomical rather than a pathological classification.

The book is divided into two parts. The first part consists of six chapters, dealing with: (1) Congenital defects; (2) Injuries; (3) Inflammations; (4) Tumours; (5) Diseases of the temporomaxillary joint; (6) Diseases of the facial nerves. The second part is divided into four chapters as follows: (1) General anaesthesia; (2) Local analgesia; (3) Asepsis; (4) Typical operations. The letterpress is very good, with clear accounts of the various clinical conditions, and the whole is profusely illustrated with excellent pictures, many of which are coloured.

It does not appear to us that the volume will be of great use to English practitioners, because, however good otherwise, it is an uneconomical proposition to need a separate book for each region of the body.

Collected Papers of the Mayo Clinic and the Mayo Foundation. Edited by Mrs. M. H. MELLISH. Vol. XVI, 1924. Royal 8vo. Pp. 1331 + xix, illustrated. 1925. London and Philadelphia: W. B. Saunders Co. 60s. net.

REALIZING that this would be at least his tenth endeavour to preach briefly on surgery with the Mayo Papers as his text, the reviewer could not fail to notice marked changes which have been brought about in these volumes. There are still weighty clinical papers which every surgeon must digest, such as that in this volume by Jean Verbrugge on gastrojejuno-colic fistulae; but they now are in a large minority, and it is no disparagement to their importance to rate them less highly than those on general scientific subjects such as that by Dr. C. Mayo on calcium, or those on experimental physiology by Mann and others on the functions of the liver and gall-bladder; these latter contain much which every surgeon responsible for the teaching of an advanced class must be able to put before them in a digested form. It appears, therefore, that whereas the earlier volumes were to the young surgeon a text-book which he must almost know from cover to cover, the *Mayo Papers* have rather come to take the rôle of a book of reference in which one can scarcely fail to find something instructive on almost any subject allied to surgery: a book to which, when in doubt as to the relative value of two different abdominal operations or some pathological problem, no teacher can apply without some ray of most valuable information.

the patient a chance of life or restoration, it is necessary to establish a free communication between the bladder and the exterior.

"The natural passage through the urethra is not available, as the channel has long been either rendered impermeable or altogether destroyed. The sound and catheter are therefore useless; while the contracted condition of the bladder forbids the operation of puncture behind the prostate.

"The surgical means adopted in these miserable cases should have a twofold object in view—an immediate and a more distant result. The one object is the prompt establishment of a free communication with the bladder behind the obstruction. The second and more remote is the restoration of the urethra to its normal condition, so far as this may be possible. For many years I have adopted an operation which is at once more easy, simple and successful than those which are in general use at the present time. However complicated may be the derangement of the perineum, and however extensive the obstruction of the urethra, one portion of the canal behind the stricture is always healthy, often dilated, and is accessible to the knife of the surgeon. I mean that portion of the urethra which emerges from the apex of the prostate—a part which is never the subject of stricture, and whose exact anatomical position may be brought under the recognition of the finger of the operator.

"Thus, when we cannot introduce a catheter by the ordinary method, and even when we cannot tap the bladder through the rectum, it still remains to us to tap the urethra as it emerges from the prostate, and thus to effect the desired communication. The only instruments required are a *broad* double-edged knife, with a very sharp point; a large silver probe-pointed director with a handle; and a canula, or a female catheter modified so that it can be retained in the bladder.

"The patient is to be placed in the usual position for lithotomy; and it is of the utmost importance that the body and pelvis should be straight, so that the median line may be accurately preserved. The left forefinger of the operator is then introduced into the rectum, the bearings of the prostate are carefully examined and ascertained and the tip of the forefinger is lodged at the apex of the gland. The knife is then plunged steadily but boldly into the median line of the perineum, and carried on in a direction towards the tip of the left forefinger, which lies in the rectum. At the same time by an upward and downward movement, the vertical incision may be carried in the median line to any extent that is considered desirable. The lower extremity of the wound should come to within about half an inch of the anus. When the operator has fully assured himself as to the relative positions of his finger, the apex of the prostate, and the point of his knife, the latter is to be advanced with a motion somewhat obliquely either to the right or the left and it can hardly fail to pierce the urethra. If, in this step of the operation, the anterior extremity of the prostate should be somewhat incised, it is a matter of no consequence.

"The knife is now withdrawn and the left forefinger is still retained in the rectum. The probe-pointed director is carried through the wound, and, guided by the left forefinger, enters the urethra and is passed into the bladder. The finger is now withdrawn from the rectum; the left hand grasps the



EDWARD COCK

1805 - 1892

director, and along the groove of this instrument the canula is slid until it enters the bladder.

"The operation is now complete, and it only remains to secure the canula in its place with four pieces of tape, which are fastened to a girth round the loins. There will probably be no escape of urine until the stilette is removed from the catheter."

The operation used to be performed with great success by Mr. Cock, who was a consummate anatomist with many years training as a teacher in the dissecting room at Guy's Hospital. It proved less satisfactory when it was undertaken by other surgeons. It gradually fell into complete disuse, being replaced by less dangerous methods. It served its purpose, however, for it displaced the practice of tunnelling the prostate—a terrible operation undertaken in cold blood and without anæsthesia. The surgeon took "a small but strong catheter, one that will not easily bend; and firm of purpose with unflinching hand, and fearless—I had almost said remorseless—heart, he carried it through all intervening tissues and obstacles into the bladder. It is as it were puncturing the bladder with a blunt instrument—tunnelling through the perineum under cover of the urethra. It is neither scientific in its conception, surgical in its performance nor anatomical in its details." Yet it lingered on, certainly until after the year 1880, for as a dresser it was my duty to support the unhappy patient as he sat shivering at the edge of a bed whilst the surgeon 'cured' the stricture. It is no wonder therefore that patients did not apply for relief until the results of the stricture had become unbearable and the perineum a mass of scar tissue or riddled with sinuses. It is largely due to the Guy's teaching that milder methods came into use by gradual dilatation and the employment of less rigid catheters.

'Old Cock' or 'Teddy Cock', as he was called affectionately by many generations of Guy's students, was one of the best beloved of their surgeons. In appearance he was a man rather below the average height, but always with a slight stoop which made him seem prematurely old. His grand head and face and pleasant expression, however, atoned at once for a somewhat diminutive frame. His delicate pink complexion; his blue eyes protected by gold-rimmed spectacles; his firm, well-chiselled, aquiline nose; and a most attractive smile, created an impression not easily forgotten. His white hair remained thick to extreme old age, and curling up at the end gave him somewhat of a gallant air, whilst his short beard being confined to lips and chin, left the dimples of his rounded cheeks exposed in laughter. A few words with him and you found that you were in the presence of a man of high culture possessed of an infinite sense of humour.

In dress he was peculiar and quite indifferent to all conventional ideas of professional attire. In summer he usually wore a large shepherd's plaid for trousers, a buff waistcoat with onyx buttons, and a silk-lined jacket, with a blue-spot necktie and low-crowned soft wide-awake hat. In winter the white hat was changed for a black one of the same shape and the silk fly-jacket was replaced by a pilot coat. A massive gold chain, a silver snuffbox, and an ivory-handled cane completed the picture. His peculiar attire was probably that which experience had taught him was most comfortable to

wear when on horseback, for Cock began to practise when consultants as well as general practitioners rode to see their patients.

Born in 1805, he died in 1892. He was a nephew, by the marriage of his aunt, to Sir Astley Cooper, and was apprenticed to his uncle at the age of 16. Uncle and nephew were akin in their love of fun and practical joking, so that the master and the apprentice were well-assorted. The master loved Cock and the apprentice became a hero-worshipper. In 1825, whilst Cock was still bound by his articles, Sir Astley Cooper resigned his lectureship on surgery at the United Borough Hospitals of St. Thomas's and Guy's, in favour of his nephew Bransby Cooper. The nomination was not accepted. Mr. South was appointed, and feelings ran so high that Guy's Hospital decided to establish a school separate from that of St. Thomas's. Bransby Cooper was appointed Lecturer on Anatomy and Mr. Cock was chosen Demonstrator of Anatomy, although he was not yet qualified and was only twenty years of age. He was admitted a Member of the Royal College of Surgeons in 1828 and was selected as one of the first twenty-seven Fellows of the College when that order was established in 1843. He worked assiduously in the dissecting rooms as Demonstrator until 1838, when he was elected Assistant Surgeon and in 1849 full Surgeon to the hospital. He remained a bachelor until 1870, when he married Miss Nunn, with whom he lived most happily until her death in 1886.

The greater part of his active life was spent in St. Thomas's Street within a few yards of Guy's Hospital, and of his doings here innumerable stories were told, some true, some *ben trovato*, but all indicative of the sociability and genuine benevolence which made him beloved alike by students and patients. At the back of his house was a 'garden' of about twenty feet square. It had a few inches of shabby grass with a fountain in the middle, the home of one eel; a fig tree, a shrub which in allusion to the speciality practised by Mr. Cock the students called 'the copaiba'; and a garden seat. An old gardener came as an out-patient to the hospital whose face was so destroyed by a rodent ulcer that no one would employ him. Mr. Cock provided him with a new nose kept in place by a pair of spectacles, and engaged him to look after his 'garden'. The man entered into the spirit of the thing, whetted his scythe, mowed the grass, made paths and borders on a microscopic scale, planted flowers in full blossom, and received his wages in due season. Master and man were alike happy so long as the illusion lasted.

Mr. Cock, like Charles Lamb, had a most engaging stutter which lent piquancy to the stories told by him or invented of him, just as Spoonerisms have been invented in these later years. It is said, probably without a shadow of truth, that the constable on night duty once found him sitting with his back to the wall facing his own house. The constable, who like all members of the force stationed near the hospital was on friendly terms with him, said, "What are you doing there, Sir"? To which Mr. Cock replied, "Waiting for Mr. C-C-C-Cock's house to come round."

Once when he was engaged at out-patients he told his class that only stupid and careless people had their pockets picked. When he had seen the last out-patient he felt for his snuffbox and found that it had vanished. He

went away saying what he thought in the highly-spiced vernacular of the period, and found a patient waiting to see him when he got home. Cock examined him, prescribed, and instead of a fee the man presented him with the missing snuffbox, saying that he had called to return it. "But, how on earth did you do it?" said Cock. "Oh, it's very easy when you know 'ow" replied the man, who then proceeded to admire the pictures on the wall, the beauties of which were explained to him. He then said 'Good-bye', and as he was being shown out he handed back the snuffbox which he had taken for the second time.

There are two portraits of Mr. Cock. The one here reproduced, to which my attention was called by Mr. John Everidge, O.B.E., F.R.C.S. Eng., shows him as a young man. The other, painted much later in life, hangs at the top of the Grand Staircase at Guy's.

ATROPHIC DISEASE OF THE SHOULDER-JOINT.

By J. P. ROSS, LONDON.

INTRODUCTION.

ATROPHY of the humerus progressing to complete disappearance of the upper end of the bone is of sufficient rarity and interest to warrant thorough investigation. The Museum of the Royal College of Surgeons contains a good specimen of atrophy of the head of the humerus, but the shaft appears unaffected (*Fig. 120*). This specimen was presented by M. Charcot, who described it in his *Leçons sur les Maladies du Système nerveux*. He used it to illustrate the rapidity with which bone destruction may take place in locomotor ataxia; for he had been able to note the time of onset of the arthropathy, and at the end of three months the head had been destroyed.



FIG. 120.—Upper end of humerus presented by Charcot. (No. 1022.1, R.C.S. Museum.)

Charcot in his original description¹ of the peculiar arthropathy which occurred only in association with disease of the nervous system dealt merely with the clinical aspects. He gave a vivid account of several cases and showed that, in his experience, the joint lesions of tabes dorsalis first appeared at a definite period in the history of the disease, when motor inco-ordination was added to lightning pains. Thus, although they may be an early manifestation of tabes, they are never the first evidence of involvement of the spinal cord. He made no attempt at this time to evolve theories with regard to the nerve cells or fibres involved.

In a later publication² he gave further descriptions of these joint lesions, dividing them up for purposes of classification into those with painful effusion occurring in Pott's disease, injury to the spinal cord, myelitis, and hemiplegia due to cerebral softening; and tabetic arthropathy in which at a definite period in the course of tabes sudden swelling of a whole limb appeared, which was later confined to one of its joints, the whole process being painless and afebrile. He added an account of the morbid anatomy of the first type, emphasizing the hyperæmia and thickening of the synovial membrane of the joint and neighbouring tendon sheaths, and stating that arthritis of neurotrophic origin might be distinguished from rheumatoid arthritis by limitation

of the lesions to joints of paralysed limbs, the sudden onset at a definite period of the disease, and the co-existence of other lesions of a like nature, such as trophic sores, muscle atrophy, and cystitis.

The arguments brought forward in favour of the trophic origin of the joint lesions of *tabes dorsalis* were: (1) That there is no evidence of a traumatic or rheumatic factor; (2) That the arthropathy appears at a constant and early stage of the disease of the nervous system; (3) That the morbid anatomy and course of the disease are quite unlike those of any joint affection of an inflammatory nature; and (4) That atrophy of the anterior horn cells is to be found in cases showing arthropathy, this atrophy not being attributable to disuse of the muscles, since it differs from the changes in the anterior horns corresponding to an amputated limb.

The grey matter of the spinal cord is frequently affected in *tabes*, usually the grey matter of the posterior horns. But if the anterior horns are involved, trophic disturbances in the limbs result. Another piece of corroborative evidence is that arthropathy has been noted in chronic anterior poliomyelitis.

In the same lectures Charcot gave some consideration to the theories brought forward to explain neuropathic arthritis. His teaching may be summarized by saying that he considered the vasomotor theory insufficient to account for the lesions, his conclusion being that vasomotor palsy or spasm alone was not capable of producing trophic disturbances. The alternative theory, which postulated the existence of trophic nerves, he believed to be more acceptable, in spite of the lack of anatomical confirmation.

The early incidence of trophic affection of joints in certain lesions of the central nervous system is now well recognized, and it is taught that cases of *tabes* may be met with in which joint disease is present before any other sign of nerve disorder can be detected.^{2,4} It is unusual, however, for the joint disease to reach an advanced stage of development before obvious signs of nervous disease may be found on clinical examination; and the present case is being placed on record because the joint under consideration had been abnormal for ten years and grossly deformed for three years before signs of disease of the nervous system were discovered.

DESCRIPTION OF CASE.

E. H., a married woman, age 45, was admitted to St. Bartholomew's Hospital under the care of the Surgical Professorial Unit in January, 1925, with the following history.

Early in 1914 she fell downstairs and injured her right shoulder. She consulted a medical man, but the condition did not demand hospital treatment or even the wearing of a support. In 1917 she noticed swelling of the right upper arm and some loss of power, which recovered under electrical treatment in three weeks. Again, in 1921, she had to give up her work—housework and washing—on account of a return of pain, swelling, and loss of power in the right arm. At that time she attended the hospital as an out-patient; her shoulder was X-rayed (*Fig. 121*), and a diagnosis of Charcot's disease of the shoulder-joint was made. Signs of disease of the nervous system were not detected, and after a short period of palliative treatment she

was able to resume her work and did not re-appear at the hospital until the time of the present admission.



FIG. 121.—Skiagram of right shoulder-joint. April, 1921.

In the interval between 1921 and the end of 1924 the condition of the arm did not worry her, her grip improved, and she was able to wash and wring clothes. Towards the end of 1924, however, she was worried by weakness of the right arm, pain in the palm of the right hand, numbness of the right shoulder and upper arm, and slight dragging of the left leg. Apart from the disability in the right arm she had not suffered from any illness in the past. She had seven healthy children,

and one miscarriage between the first two children. She had never suffered from any form of joint disease.



FIGS. 122, 123.—Showing the deformity of the right shoulder and the narrowing of the palpebral fissure on the right side.

Examination of the patient revealed great deformity of the right upper arm. There was a marked hollow below the acromion, and the head of

the humerus could not be palpated (*Figs. 122, 123*). Active movement of the shoulder was practically absent, the patient being able to get about 30° of abduction and 15° of anteroposterior movement; the joint could be moved passively very freely in all directions, soft crepitus being detected. There was only half an inch of wasting of the arm. The length of the arm varied within a range of nearly three inches according to the state of contraction of the deltoid muscle. The right hand was slightly 'clawed' and the interossei were wasted; the skin was noticed to be coarse, but no trophic lesions were found. Movements of the right elbow and wrist were full and strong, and signs of disease could not be detected in any other joint. A considerable degree of scoliosis was present.

There were definite signs of involvement of the spinal cord in the cervical region. They were paresis of the right cervical sympathetic, definite hypalgesia of the right side of the face, neck, and arm, and impairment of thermal



FIG. 124.—Skiagram of right shoulder-joint. October, 1924.

sense over the right shoulder and arm. Vibration sense was lost in the right arm. There was slight hypaesthesia of the right face and right arm, but this was not nearly as marked as the loss of pain and temperature sense. The left leg showed muscular weakness, there was exaggeration of the left knee- and ankle-jerks, and the left plantar response was extensor. The patient showed no signs of syphilis, and the Wassermann reaction in the blood was negative.

Skiagrams of the joints showed that the head and neck and upper part of the shaft of the humerus had disappeared almost completely. The first skiagram (*Fig. 121*) was taken in 1921, and it is interesting to compare it with the skiagrams (*Figs. 124, 125*) taken in 1924. Apart from the fact that the upper end of the shaft of the humerus had become smoother and more rounded

off, there was very little X-ray evidence that the lesion in the shoulder-joint was progressing, the other bones and bony abnormalities being almost unchanged in the interval. Besides the absorption of the head and part of the shaft of the humerus the changes in the scapula must also be carefully studied. Attention is drawn to the enlargement of the glenoid, which appears to be even shallower than normal, and to the new bone laid down at and below its inferior border, to which reference will be made later.

COMMENTARY.

In attempting to arrive at a diagnosis of the condition the possibilities which had to be considered were:—

1. That the humerus had been fractured at the time of the original accident, and that the subsequent atrophy of the head and upper part of the shaft was due to interference with nutrition brought about by the fracture.



FIG. 125.—Skiagram of right shoulder-joint.
October, 1924.

2. That the condition was a manifestation of the atrophic type of arthritis deformans.

3. That the condition was a neuropathic arthropathy.

If the first or second possibility was to be accepted as the correct solution of the problem, then the signs of nervous disease which were discovered at the last examination would have to be taken to indicate an early stage of some intercurrent nervous disease having no relationship to the joint affection.

1. Trauma.—As far as the possibility of a fracture having been the original cause is concerned, it would appear that the patient's own history of the injury is the best argument against its being the correct one. She stated that, although she fell heavily and bruised her shoulder severely, yet she was not disabled for any appreciable length of time, being able to carry out all her work without pain a few days later; and she never had to wear a sling or any form of splint after the accident.

It is interesting to note, however, that a history of an accident too severe to be entirely disregarded as a causal factor is sometimes obtained in cases of undoubted neuropathic arthropathy. As an example of this one may cite the case, recorded in Marsh and Gordon-Watson's *Diseases of the Joints and Spine*, of "a hawker who sustained an injury (probably rupture of some

muscular fibres) to his shoulder one year previously, followed by a swelling which gradually subsided. Four months later a sudden painless effusion occurred in the same joint, and two months afterwards well-marked grating was observed". This patient showed signs of syringomyelia. It may be that the injury determines the particular manifestation of the disease of the nervous system, and this supposition receives support from animal experiments carried out by Eloesser,⁵ who was able to show that typical neuropathic arthropathy could be produced by inflicting injury on a joint in a limb which had been deprived of its sensory nerve supply by previous division of the corresponding posterior roots.

It was suggested that a fracture near the head of the humerus might lead to absorption of the upper end of the bone in the same way that absorption of the head of the femur may follow fracture of its neck. A good example of this condition is afforded by another case recently under the care of the Surgical Unit at St. Bartholomew's Hospital.

The patient was 5 years of age, and it was stated that when 6 months old she fell out of her perambulator and injured the left hip. Two weeks later a skiagram showed a fracture through the neck of the femur, and the limb was put up in plaster. The plaster was changed every three months, and in the course of four and a half years her lesion came to be regarded as tuberculous arthritis of the hip-joint.

On examination, flexion and extension were found to be free at the left hip, but abduction was limited. The head of the femur could not be palpated. The left leg was considerably wasted and shortened. There was no evidence of old inflammatory mischief in the joint. Skiagrams showed absence of the head and neck of the femur, the top of the shaft articulating with a flattened false acetabulum (*Fig. 126*). Within a few days she learnt to walk without pain, and was sent home wearing a caliper splint.

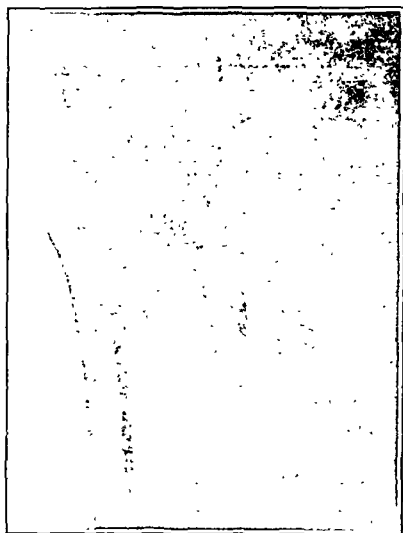


Fig. 126.—Skiagram of left hip-joint (posterior view), showing absorption of the head and neck of the femur.

The collection of Nubian bones recently added to the Museum of the Royal College of Surgeons contains several specimens of femora from which the head and neck have been worn away, and it is believed that in these also the condition can be explained by fracture of the neck of the bone with subsequent atrophy and absorption of the proximal fragment.

There is no reason to suppose that the head of the humerus is comparable to the head of the femur in this respect. It is possible for small fragments of bone torn off the upper end of the humerus to become absorbed and disappear, but I can find no reference to any case of absorption of the whole head of the humerus after fracture through the neck.

2. Arthritis.—In considering the second possibility, that the joint lesion might be a manifestation of arthritis deformans, there are several points

which can be made in its favour. Injury is frequently associated with the onset of this disease. Also, in arthritis deformans of the shoulder-joint the deformities of the glenoid may be very similar to those seen in this case—enlargement of the fossa, which becomes shallower than normal, with ossification extending downwards into the long head of the triceps muscle. It is well known that rarefaction of the cancellous tissue at the end of a long bone may take place to such an extent that bending of the bone results; but cases of actual loss of considerable parts of the bone are rare, though dislocation due to bone loss, and not resulting from stretching of peri-articular structures, has been recorded.

In this connection reference may be made to a specimen in the Museum of the Royal College of Surgeons (No. 1922), presented by Mr. Jonathan Hutchinson, and described in the catalogue as follows:—

“The bones of a right upper extremity. All the bones appear lighter than normal, the scapula especially being unusually thin and transparent. The glenoid cavity and the head of the humerus have been completely absorbed. The tuberosities alone remain. Upon the inner surface of the shaft of the humerus, just below the tuberosities, is a concavity, directed from above downwards, and which has extended half through the bone so that the medullary canal is widely exposed. The concavity has apparently been produced by the friction of the displaced humerus against the semilunar concavity of the scapula upon which it moved” (*Fig. 127*).

An abstract of the clinical history is appended, from which it appears that the patient was aged upwards of 60, emaciated, and bedridden. The shoulders, elbows,

wrists, knees, and interphalangeal joints were affected symmetrically. There was a deep hollow under each acromion, and the head of the humerus had evidently been absorbed to a great extent and displaced towards the axilla. A description of the other joints is given, and then it is stated that there was not the slightest swelling of the parts adjacent to the joints, that there was great wasting of the limbs, but the fingers looked quite natural. The malady began in the patient's shoulders and gradually progressed. She suffered great pain in the joints, though movement gave no pain. Her pupils reacted to light, and she had no bladder symptoms. The malady



FIG. 127.—Shoulder-joint. (No. 1922, R.C.S. Museum.)

was believed to be "chiefly one of general rheumatism", and it seems possible that it may have been one of the rare instances of arthritis deformans associated with marked bone destruction.

In the case at present under consideration there are several points against the diagnosis of arthritis deformans. Pain and limitation of movement are the rule in arthritis deformans, whereas the outstanding features in the present case are weakness and abnormally free mobility. Also, if those rare cases referred to above be left out of consideration, the common change in the humeral head in arthritis deformans is enlargement, lipping, and flattening. In short, abnormal mobility and actual loss of bone, both of which are present in this case, are two of the important features differentiating a neuropathic joint affection from arthritis deformans.

3. Neuropathic Arthropathy.—By a process of exclusion, therefore, as well as by clinical examination of this case, one is forced to the conclusion that the condition of the shoulder-joint is neuropathic in nature. This is confirmed by descriptions given of specimens and of other cases in which disease of the joint was proved to be a manifestation of a lesion of the nervous system.

With regard to the specimen presented to the Royal College of Surgeons by Charcot (*Fig. 120*), the Museum catalogue states :—

"The head of the bone has been completely destroyed, the articulating area formed by the upper end of the shaft being slightly convex, and for the most part smooth and eburnated. Patches of new bone have been produced on the external aspect of the shaft and elsewhere in the neighbourhood of the new articular surface. The compact wall of the shaft is thinned by atrophy."

In the above description no mention is made of the state of the glenoid, but it is stated elsewhere that in Charcot's disease "the glenoid cavity is replaced by a large articular hollow bounded above and in front by the acromion and the coracoid process and below by a mass of new bone springing from the axillary border of the scapula and produced apparently by ossification of the long head of the triceps" (Marsh and Gordon-Watson). This mass of new bone can be seen well in the skiagrams of the present case (*Figs. 121, 124*).

Charcot's specimen described above was obtained from a shoulder in which the disease was only moderately severe. It is usual for these lesions of the shoulder-joint to give the appearances characteristic of the atrophic type of Charcot's disease, with much effusion in the early stages, and extensive bone destruction later. Dujarier⁶ summarizes his experience by saying that, besides the head of the bone, frequently several centimetres of the diaphysis are absorbed, and it is possible to introduce several fingers between the prominence of the acromion and what remains of the upper end of the shaft of the humerus. He illustrates his article in Le Dentu and Delbet's *Traité de Chirurgie* with a photograph showing advanced bilateral tabetic arthropathy of the shoulder-joints, each joint appearing in the picture to be as extensively diseased as the shoulder now being described.

It is possible for various lesions of the central nervous system to produce such trophic changes in the shoulder-joint; and in this case the clinical signs, slight though they are, suggest syringomyelia in the cervical region of the

spinal cord as the most likely cause. The shoulder is the joint most commonly affected in syringomyelia, and the sensory impairment, the wasting of the muscles of the hand, the cervical sympathetic paresis, the pyramidal tract involvement, and scoliosis may all be taken to be manifestations of this disease. It is stated that syringomyelic joint affections are more common in males because men are more exposed to injury than women. In this case, however, there is the history of trauma severe enough to justify the belief that it is an exception to the general rule. The loss of a considerable length of humerus and the tendency to ossification in the triceps muscle are recognized as characteristic appearances in syringomyelia.

The time of onset of arthropathies in the course of syringomyelia varies considerably in different cases, and it is stated by Dujarier that, although as a rule well-marked signs of nervous disease precede the joint manifestations, yet the latter can be the first sign of disease, as in the case under discussion. The same author also quotes examples showing that the arthropathy of syringomyelia may progress for twenty, thirty, or even thirty-five years.

TREATMENT.

The only treatment worthy of consideration would be an operation planned to give greater stability to the shoulder by fixation of the joint. Consideration had to be given to the fact that the woman had fairly good function in the right arm and was able to do her housework, and even to wash clothes in spite of the undue mobility and weakness of the shoulder. The increased risk of suppuration and of delayed and imperfect healing owing to the trophic affection of the tissues was taken to contra-indicate operative treatment. Also it had to be borne in mind that weakness of the left leg was becoming a more troublesome feature. This evidence of spreading involvement of the cord was a further argument against treatment of the shoulder itself.

The patient has been examined from time to time since the beginning of 1925, and the decision not to operate on the joint has been justified by the subsequent course of the case. The shoulder remains practically unaltered, but the legs are becoming progressively weaker.

I wish to acknowledge my indebtedness to Professor Gask for permission to publish these cases; to Sir Arthur Keith for allowing me to make full use of the specimens in the Royal College of Surgeons Museum; and to Miss Vaughan, of the Dunn Laboratories, for her help with the illustrations.

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- ⁴ CHOYCE, *System of Surgery*, 1923, iii, 972.
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INTRACEREBRAL CALCIFICATION.

By JOSEPH J. LEVIN, JOHANNESBURG.

INTRACEREBRAL calcification is a relatively rare condition—so rare, in fact, that when Heuer and Dandy made an exhaustive study of the subject in 1916 there had been only seven cases previously reported. I can find no mention of such a case in any of the common text-books of surgery. Since Heuer and Dandy's publication in 1916 a few more cases have been published by different authors, but I think I am right in saying that not more than twenty or thirty cases of intracerebral calcification, definitely proved either by operation or autopsy, have been reported. As far as I can ascertain from the journals which are at my disposal, and from correspondence with Mr. D. M. Greig, Conservator of the College of Surgeons Museum, Edinburgh, not one of these cases is an exact counterpart of my first case, and of what I believe my second to be.

E. J. Heuer and W. E. Dandy¹ say they have found only twenty recorded cases of calcification of tumours. A tumour recognized by X rays, described by A. Church² in a boy of 15, was found *not* calcified. Calcification of an aneurysm is recorded by Heuer and Dandy.³ J. W. Ogle⁴ records calcareous and bone formation, but no case of a hæmatoma apparently. Probably most of his 14 cases were of healed tubercle; at any rate there was pulmonary tubercle in 6. Only one case had recurring epilepsy. The same author⁵ records the case of a male, age 35, who had had pain in his head for two years after having had his arm broken in a fall. Later, he frequently vomited, became very tremulous, and then had dysphagia for a week, and died with stertorous breathing soon after admission to hospital. The post-mortem examination showed the dura in the middle fossa puckered and thickened, brick-red in colour, and adherent to the brain. Underlying this on each side the brain was a small cavity containing hæmatin crystals. The case is not too fully described, but was evidently a hæmatoma following injury. There was no note of the cysts having calcified walls.

L. Rokitansky⁶ writes of the formation of blood cysts following injury. "The walls of the sac, especially that one which adheres to the dura mater, sometimes become the seat of ossification, that is, of bony concretions in the form of plates." The word 'ossification' in those days was often used instead of 'calcification'.

J. T. Murphy publishes the case of a primipara, age 47, who had convulsions affecting only the right side two to four times yearly during seven years. A radiogram showed a barrel-shaped mass which he considered a calcified cyst. He gives a few references,⁷ but none of a calcified hæmatoma.

E. A. Miller⁸ records the case of a man, age 60, who had recurring epilepsy during twenty-six years, with pain in the left parietal region. The twitching began in the right hand and affected the right side of the body.

The calculus was removed successfully by operation, and the organic basis was 'decomposed' blood. There was no history of injury, but that seems to me to be the most likely source of such an affection.

John O'Sullivan,⁹ in an article entitled "Some Rarer Intracranial Calcifications and Ossifications," classifies calcifications into four groups, namely: (1) Symmetrical retro-bregmatic ossifications of the dura; (2) Calcified cysticercus; (3) Calculi in the brain; (4) Calcified tumour.

None of his cases or groups corresponds exactly to my cases. In some there is a history of injury. A skiagram of the case in the fourth group, figure 15, is somewhat similar to that of my first case, but the pathological report of his specimen is entirely different. He states that the clinical history and findings, together with the X-ray examination, lead to the conclusion that the war injury was *not* responsible for the patient's condition. This case, he says, was probably a psammoma.

Of my own two cases, one was referred to me by Dr. Harte, and the other by Drs. Heimann and Campbell. The diagnosis of the first case was proved conclusively by successful operation. In the second case, as the symptoms were by no means inconveniencing the patient, I did not feel justified in operating on her, and therefore have not so far proved the diagnosis conclusively. The history, however, is so exactly like that of the first case, and the skiagram so suggestive, that one has come to the conclusion that the nature of the mass is the same.

REPORT OF AUTHOR'S TWO CASES.

Case 1.—This case was shown at the monthly meeting of the Witwatersrand Branch of the British Medical Association in October, 1925. The history is as follows:—

The patient, an Indian, age 21, who resides in Standerton, consulted Dr. Harte on July 20, 1925, complaining of headache and attacks of 'shivering' of the right arm and leg.

He is a tailor by trade, is married, and has two healthy children, age 2 years and 2 months respectively.

PERSONAL HISTORY.—His father states that he came to South Africa between the ages of seven and eight, that he went to school but was not very clever there. He learned to read and write English, but has forgotten that art; he can, however, read and write his own language. He is clever as far as money matters are concerned! In 1910, when he was 6 years old, he had a fall and sustained a fracture of the right forearm and also an injury to the *right side of his head*. About ten days after the accident he felt faint and vomited. He had a similar attack twelve months later, and these attacks became more frequent as time went on, recurring every six months and lasting only a few minutes. Before each attack he complained of seeing 'double'. About three years ago, in 1922, during one of these attacks his *right hand* began to 'shiver', and his fingers opened and closed involuntarily. The 'shivering' spread up his arm, then down the *right side* of his body to the thigh, leg, and toes. Both the upper and the lower limb performed constant movements during the attack. The attack lasted seven or

eight days; he slept very little during the period, but when he did sleep the movements of the limbs stopped. Three months later he experienced a similar attack, and noticed that a few days beforehand he had pain in both ears and was slightly deaf, and that a tingling in his right fingers preceded the attack. Since then he has had similar attacks about every three months, lasting from three to eight days.

About two years ago, whether during one of these attacks or not we cannot ascertain, he has the history of a severe headache accompanied by blurred vision and aphasia (he understood what was spoken to him and he could speak, but his friends did not know what he was talking about—jargonaphasia). This lasted one week, and he has had similar attacks since.



FIG. 128.—Case 1. Skiagram showing the calcified patch in the left temporoparietal region.

During all these attacks the 'shivering' was confined to the *right side of the body*; he was never completely unconscious. There is also a history of three bouts of vomiting during June, the month before coming under Dr. Harte's observation. His father states that he had some treatment for this condition before 1922. Since 1922 he has been constantly under treatment by three or four doctors.

FAMILY HISTORY.—Nothing to note. His father and mother are alive and apparently healthy.

OPHTHALMOLOGIST'S REPORT.—"Vision, tension, fundi, and extra-ocular muscles are normal. Pupils slightly dilated, but react normally. Wernicke's hemiopic pupillary reaction is negative. The field of vision shows a right homonymous hemianopsia.

"His cerebration is slow, and his general intellectual capacity is diminished. His perception of superficial and deep-seated sensibility is normal. His stereognostic sense is normal. He has no apraxia, either ideologic or ideomotor. He has no aphasic phenomena of any form."

RADIOLOGISTS' REPORT.—An X-ray photograph (*Fig. 128*) was taken by Drs. Steuart and Olivier, who reported as follows:—



FIG. 128.—*Case 1.* The patient before operation.

"There is an irregular calcified patch in the left temporoparietal region lying in the brain, apparently about $\frac{3}{4}$ in. deep. The appearances are compatible with a calcifying abscess, hæmatoma, or new growth."

PHYSICIAN'S REPORT.—"Heart, urine, chest, and lungs normal. The reflexes were normal. There was no Rombergism and there was no nystagmus."

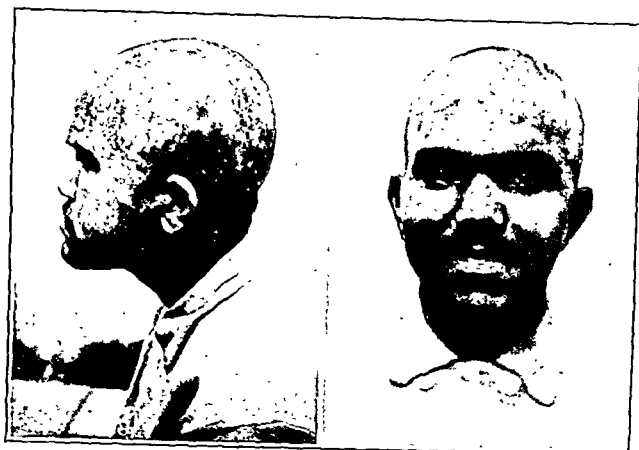


FIG. 130.—*Case 1.* The patient after operation.

Personally I never saw this patient in any of his attacks, but when I saw him he looked dull and stupid (*Fig. 129*).

Judging from the reports of the radiologist and the ophthalmologist there was no doubt that there was a foreign body in his brain. There was also no doubt, judging from the history of attacks of headache and Jacksonian epilepsy increasing in frequency and severity, from the

situation of the foreign body as shown by the skiagram, and from the eye symptoms, that they made a complete picture and made it reasonably certain that the foreign body (whether it was a calcified hæmatoma, or calcified tubercle, or a calcified abscess or a tumour) was the cause of all the man's trouble. I therefore resolved to operate with a view to removing the mass.

OPERATION.—On Saturday, August 29, I operated on the patient under

intraparyngeal ether. Dr. Harte assisted me. I turned down a large scalp flap (shown in *Fig. 130*), taking as my base-line the top attachment of the ear. After denuding the skull bones of pericranium, I made four openings in the skull, with graduated burrs. Then with a hammer and chisel I removed the flap of bone between the four openings; the size of the flap is indicated in the X-ray photograph (*Fig. 131*).

Having removed this flap of bone, I left it lying on the scalp flap and attended to bleeding points. There was, strange to say, no bulging of the dura. So obvious was this fact that the onlookers noticed it. I then incised the dura in a cruciform manner. The brain did not bulge at all. I then insinuated my finger between the dura and the brain and orientated myself

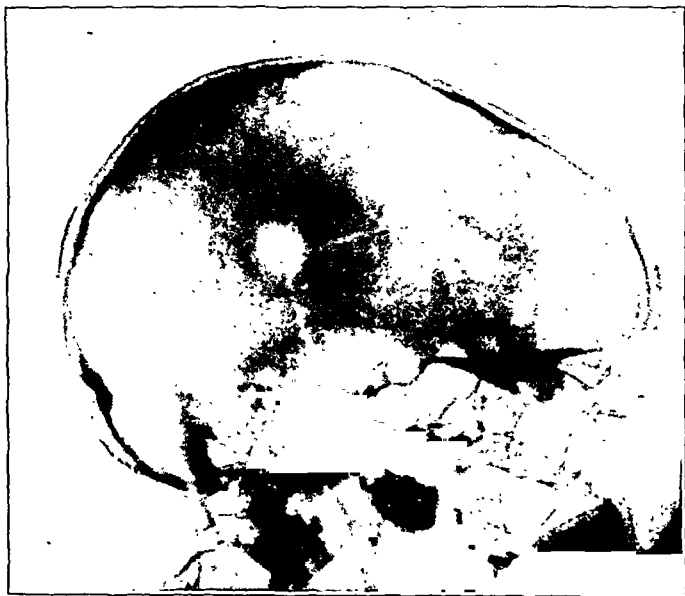


FIG. 131.—Case 1. Skiagram showing the size of the bone flap. The skiagram is reversed.

in the middle fossa. My opening was in such a position as to make it easier for me to get my finger round the front of the temporal lobe than round the back. During the process of passing my finger round the back of the temporal lobe I felt a 'spiky' projection through the surface of the brain, and knew that I was on the foreign mass. I gently pushed my finger into the brain—the temporosphenoidal lobe—and gradually worked my way round the whole mass until I had it free in the brain. I then began to extract it, and with the assistance of the forefinger of my left hand brought it out from the opening in the skull. There was a good deal of oozing from the cavity in the brain, which I eventually stopped by repeated gentle plugging with gauze. Fearing a collection of blood in the cavity after the operation, I left a split rubber tube in the cavity, with a strip of gauze in it. The dura

was then folded back from the brain, but not stitched. The bone flap was replaced, and the end of the rubber tube brought through the posterior inferior 'trephine' opening and through a stab wound in the skin behind the ear. The scalp was then completely stitched up.

The whole operation lasted about an hour and a quarter to an hour and a half.

The patient was put to bed, and as his blood-pressure was fairly low, his temperature subnormal, and his pulse rapid, camphor, digalin, and pituitary were administered hypodermically, and salines subcutaneously and rectally.

The mass removed is shown in *Fig. 132*. It will be noticed how accurately this corresponds with the original skiagram taken before the operation.

SUBSEQUENT HISTORY.—There was some anxiety about the patient's condition for three weeks, but he looked well and felt well, and discussed how soon he would be able to get out of bed and use the commode and go to the lavatory. The rubber tube was removed after forty-eight hours. On Sept. 10 I did a lumbar puncture and had the fluid examined at the Institute for Medical Research. I received the following report:—

"Microscopic examination of the centrifugalized deposit of this fluid shows abundant polymorphonuclear leucocytes with some small lymphocytes (in the proportion of 4:1). No organism seen on direct examination. Cytological examination shows 2600 cells per cubic millimetre of the fluid. Cultivation has afforded a negative result."



FIG. 132.—The calcified mass removed in Case 1.

This suggests that blood had trickled down into the spinal column, probably through the cavity from which the mass was removed. On Sept. 13 his temperature and pulse were nearer normal. On the 14th, however, his temperature rose to 104° and

his pulse-rate to 128. I suspected malaria, and treated him with quinine. His blood was not examined before giving him the quinine, but a day or two later gave a negative result. Examination of his stools was also negative.

We had in the meantime started saline bowel wash-outs on general principles on Sept. 10; this was continued till Sept. 23, by which time his temperature had settled, his stools were normal, and he was giving us no more anxiety. Before we arrived at this comfortable stage, however, we noticed that his mouth was very septic, and on two occasions we asked dentists to examine him and tell us whether in their opinion dental sepsis could be the cause of his temperature. One of them thought it might be, and the other thought it could not.

He was discharged from the nursing home on Oct. 4, and, as shown in *Fig. 130*, appears perfectly well. The photograph taken before operation (*Fig. 129*) is that of a sullen, morose, suffering individual; that taken after rather suggests a happy individual. The headaches have ceased, he has had no more attacks of Jacksonian epilepsy, and in my opinion the skull flap is fixed in position.

PATHOLOGICAL REPORT.—The specimen was examined at the South

African Institute for Medical Research (A. Sutherland Strachan), and the report was as follows :—

“The specimen was sawn through longitudinally, and portions taken for examination from the outer irregular surface and from the centre of the mass. Sections of these portions show a laminated calcified mass, with traces of altered blood pigment, and an amorphous mass with calcifying spicules scattered in its substance. There is no evidence of tumours or of tuberculosis. The features are those of a calcified hæmatoma.” (Fig. 133.)

In view of the fact that the injury to the skull was on the right side, the hæmorrhage was undoubtedly due to *contre-coup* injury.

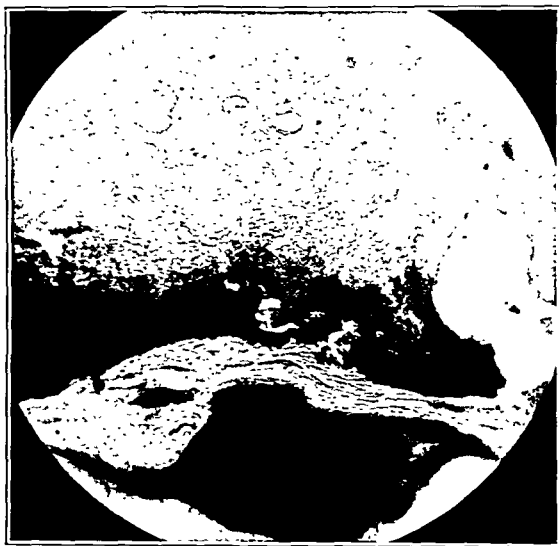


FIG. 133.—Microscopic section of the calcified specimen in Case 1.

Case 2.—A single woman, age 29, whose parents were a ‘Malabar’ coolie and a Hottentot. She came to hospital for chest trouble, cough, vomiting, and asthma, on Oct. 23, 1925. Her sinuses were suspected of being the focus of infection, and her skull was X-rayed, when an apparently calcified mass was discovered in the *right* cerebral hemisphere (Fig. 134). After this we obtained the following history, but without suggestion :—

HISTORY.—“Many years ago, when a child, she fell out of a tree and struck the ground with the *left* side of her head. She did not become unconscious. At the end of December, 1924, she had a headache in the frontal region, for which she took medicine. A few days later she noticed jerking movements of her *left upper limb*. Six months afterwards she had another attack of jerking movements of four hours’ duration, but this time the *left leg* as well as the *left arm* were involved. A couple of months later another attack of headache superseded, followed by jerking movements of the *left upper and lower limbs*, and lasted about ten hours”. She suffered from palpitation after the attacks.

One must assume that these jerking movements of her limbs are Jacksonian epilepsy. Since she has been in hospital, she has had one attack of headache, but no Jacksonian epilepsy.

ON EXAMINATION.—The patient was a small coloured woman, with the left side of her body very slightly less developed than the right.

X-ray Appearances.—See Fig. 134.

Nervous System.—Reflexes: Cranial nerves, nothing abnormal. Left arm: biceps ++; triceps ++; brachioradialis ++. Right arm, normal. Left leg: knee-jerk ++; ankle-jerk ++. Right leg: knee-jerk +; ankle-jerk +. Abdominal reflexes elicited on either side. Plantar reflexes, doubtful. Right arm, muscle power good. Left arm, muscle power weak. Right leg, muscle power good. Left leg, muscle power weak.

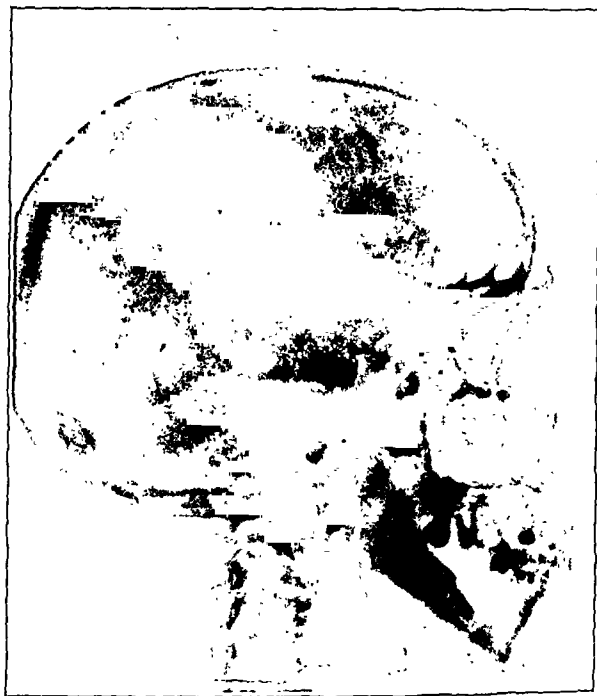


FIG. 134.—Case 2. Skiagram showing an apparently calcified mass in the right cerebral hemisphere.

Sense of position with the right leg and arm, normal. Left leg, normal; left arm, impaired.

Sense of touch: right side, normal; left side, normal.

Sense of heat and cold: right side, normal; left side, cannot differentiate between heat and cold on the inner aspect of the tibia from knee to ankle.

Circulatory System.—Cardiac, nil.

Respiratory System.—Bronchitis.

Ophthalmologist's Examination.—Pupils equal and normal. Field of vision full. Discs normal.

Aural Surgeon's Examination.—Nasal examination, negative; naso-

pharynx, negative; tonsils, small, flat, healthy. Some bad teeth. Larynx and epiglottis. vocal cords move freely. Hearing, whisper heard easily 6 ft. or more on either side.

L.M.T.: results of chronic suppurative otitis media, perforation in postero-superior quadrant, showing incus. R.M.T.: results of chronic suppurative otitis media. large postero-superior marginal scar.

Caloric test: left ear, nystagmus 50 sec., right; right ear, nystagmus 50 sec., left; past-pointing, not reliable.

Turning to left, 22 sec. after nystagmus. Turning to left, past-pointed 4 in. to left with the left, and 1 in. to the left with the right. Turning to right, 20 sec. after nystagmus. Turning to right, past-pointed 3 in. to right with the right, and 1 in. to right with the left.

Conclusion: Labyrinth tests yield normal results, bearing in mind that the left side of the body is weaker and not so well developed as the right.

DIAGNOSIS.—One is of opinion that there can be little doubt, judging from the history, the skiagrams, and the examination, that this woman's symptoms are due to the presence of a small 'foreign' mass in her brain, and that the mass is situated in the Rolandic fissure area on the right side of the brain near the arm area. The nature of the mass I believe is similar to that of the first case, namely, a calcified hæmatoma. In this case, however, unless the headaches and Jacksonian epilepsy become more frequent and severe, one feels that there is no justification for attempting the removal of the mass.

Of the fourteen references, I have been able personally to consult four; the others are not available in South Africa.

I am indebted to Dr. A. Sutherland Strachan, of the South African Institute for Medical Research, for the pathological report; to Mr. D. M. Greig (Edinburgh) for assistance in the matter of references; and to Drs. Harte, Campbell, and E. B. Israel for valuable assistance with the cases.

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MYELOMA AND CAVITIES IN BONE.

By R. P. ROWLANDS, LONDON.

MYELOMA is an innocent tumour of bone which grows from the red marrow, which it closely simulates in structure, being chiefly composed of multinucleated giant cells embedded in spindle and round cells. It has almost the same distribution as the red marrow, but is especially common in the upper end of the tibia and the lower end of the radius; the femur and the humerus are also frequently affected. It is curious, as Sir John Bland-Sutton¹ states, that this disease rarely affects the abundant cancellous tissues of the bodies of the vertebræ. There is a specimen in the Museum of the Royal College of Surgeons showing this growth affecting the patella; the limb was amputated after exploration.

It was, at one time, common to mistake this growth for myeloid sarcoma, but it is now generally recognized that myeloma is not malignant; it does not disseminate, but may be very destructive locally, if neglected. Under these circumstances the femur or the tibia may be so extensively involved that an amputation may seem to be the only reasonable and hopeful treatment. I am describing two cases to demonstrate that this view is fallacious and that the limb can be saved with complete restoration of function. I will also deal very briefly with some earlier cases which led me to what I regard as the correct treatment of this disease.

Case 1.—About twenty-five years ago a young Mauritian was hit on the outer side of the tibia by a cricket ball. Before long the tibia began to swell and cause severe pain. The swelling gradually increased, and when I saw him, some months later, there was a large swelling just below the knee, with egg-shell crackling over the outer tuberosity of the tibia, and undue mobility of the head of the fibula, which had been displaced outwards by the growth. At an exploration with the aid of a tourniquet, a large typical myeloma was found occupying about three-fourths of the upper

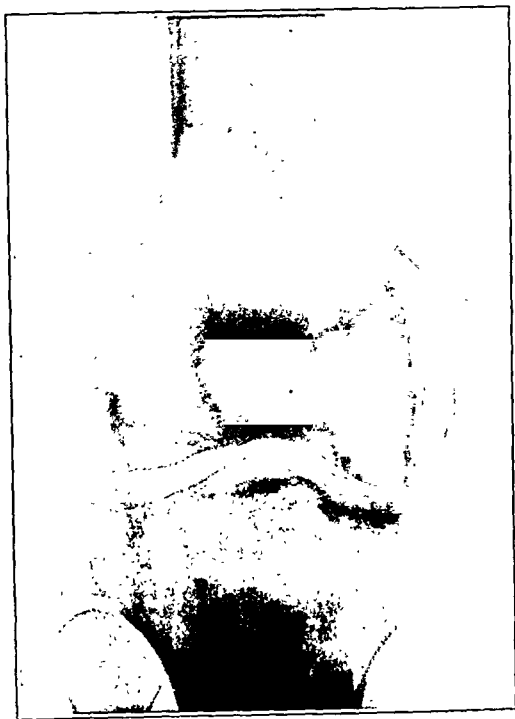


FIG. 135.—Case 3. Myeloma of femur. Before operation.

Case 1.—About twenty-five years ago a young Mauritian was hit on the outer side of the tibia by a cricket ball. Before long the tibia began to swell and cause severe pain. The swelling gradually increased, and when I saw him, some months later, there was a large swelling just below the knee, with egg-shell crackling over the outer tuberosity of the tibia, and undue mobility of the head of the fibula, which had been displaced outwards by the growth. At an exploration with the aid of a tourniquet, a large typical myeloma was found occupying about three-fourths of the upper

end of the tibia, some healthy bone remaining on the postero-internal surface. The growth had protruded out of its shell on the outer side, invading the extensor muscles, but had not pierced the articular cartilage into the knee-joint. It shelled out quite easily, and the walls of the cavity were carefully curetted with sharp spoons of various sizes. The cavity was washed out with an antiseptic solution.

Section proved that the growth was a myeloma, and the late Mr. L. A. Dunn agreed with me as to the diagnosis and treatment. Both he and I hoped that the limb could be saved, and that the cavity, which was temporarily drained, would gradually fill with bone. A Parisian surgeon, however, was sent for by the patient's father, and he urged amputation. The father agreed with him, and unfortunately I very reluctantly amputated through the lower third of the thigh. A naked-eye examination of the tibia after amputation, and eighteen microscopic sections of the wall of the cavity, showed that there was no sign of growth; therefore it is clear that, with more knowledge and confidence, the limb could have been saved and its functions restored. I am glad to say the patient was quite well when I saw him nearly twenty years later, when he came over to give what service he could during the War.

Case 2.—In May, 1914, the chauffeur to Dr. Duncan, of Lee Green, a man of 39, fell with his right knee doubled under him. He was in bed for two or three days, suffering considerable pain and swelling of the knee. I saw the patient in September, 1915, when a radiogram taken elsewhere had shown absorption of the centre of the bone. A diagnosis of central sarcoma had been made and amputation recommended, but the patient preferred to come to Guy's Hospital for treatment. I operated on Sept. 7. After applying a tourniquet around the root of the thigh, I made a longitudinal incision over the prominence on the front and inner side of the lower end of the femur, and removed a strip an inch wide of the shell covering the growth. This shell was thicker than I had expected, being about one-third of an inch. The growth was very soft; in parts it was like dark clot, and in others white and almost caseous. There was also in parts a greenish membrane between the growth and the shell of bone.

Dr. G. W. Nicholson immediately examined the growth, and found many giant cells; he reported that it was a myeloma and not a myeloid sarcoma. Therefore I scraped it out with great care and applied a solution of formalin (1-250) to the walls of the cavity and the lips of the wound, with the idea of destroying any cells of growth that might be left. The resulting cavity was very large, occupying the whole of the lower end of the femur and about three inches of the central canal of the shaft, which had been somewhat expanded. I scraped away until I reached the healthy marrow of the shaft.

After the operation the femur did not bend on exerting lateral pressure, nor did



FIG. 136.—*Case 3.* Myeloma of femur. Before operation.

it give way when one pushed the heel forcibly upwards. The wound was completely closed with the idea of letting the cavity fill with blood, which in time might be expected to ossify. If this plan should fail, bismuth paste or sterilized paraffin could be employed to fill the cavity, or a silver tube could be left in to drain it. When a large and extensive dressing had been applied and firmly bandaged, the tourniquet was removed and the limb well raised on pillows in bed.

Three weeks later there was a discharge of blood-stained serum from the wound, but the patient did well, had no fever and no further discharge. He wore a caliper splint for some months, and radiograms were taken from time to time showing the gradual ossification of the contents of the large cavity in the lower end of the femur. Ultimately the man made a complete recovery and discarded his splint. Unfortunately he was lost sight of during the War and has not been traced since.



FIG. 137.—Case 3. Myeloma of femur. Seven months after operation.

Case 3.—E. V. B., a man, age 29, was admitted to Guy's Hospital on July 6, 1925. Eight months earlier, while playing football, he had noticed something 'go snap' on the inner side of the right knee. Two months later there was slight swelling of the right knee-joint, associated with pain. This swelling gradually increased, and in March, 1925, it had spread to the front and outer side of the thigh just above the knee. The knee was treated for synovitis and put in plaster for a month.

ON ADMISSION.—The swelling was then larger, firmer, and more adherent to the skin: there was no pulsation or eggshell crackling. Radiograms (Figs. 135 and 136) showed a large, circular, pale area in the region of the external condyle and shaft of the femur. They indicated a central tumour which had pierced the bone in front and had stripped the periosteum considerably; the line of this showed ossification.

OPERATION.—The femur was explored through an incision along its outer border, after applying a tourniquet around the upper third of the thigh. As anticipated from the roundness and sharp margin of the pale area in the femur, the growth turned out to be a myeloma. It shelled out easily, and the surrounding parts were thoroughly scraped; but the shell had been perforated by the growth posteriorly,

towards the popliteal space, and also on its antero-external surface. The tumour was the size of a tennis ball, partly inside and partly outside the femur. Microscopic section proved it to be a typical myeloma. The cavity was allowed to fill with blood, and later to ossify.

A fortnight after the operation the patient walked with a caliper splint, which he was allowed to leave off at night after four months, and by day after five months, when he was able to stand and walk quite well. Several radiograms, taken at intervals, had shown increasing ossification of the contents of the cavity, and the limb had become more and more firm. He is now able to bend the knee to a right angle, and to walk quite well without support or stick. Radiograms taken early in 1926 show no sign of recurrence of the disease (Figs. 137 and 138).

Case 4.—A. G., a man, age 20, was admitted to Guy's Hospital on Aug. 24, 1925, for X-ray examination of the left knee. He had first experienced pain in the knee when walking, two months before. This had passed off for a week, but had recurred with increasing intensity and had not yielded to palliative treatment. The X-ray plate showed a large circular pale area in the internal tibial tuberosity suggestive of myeloma. This area was very tender to touch and painful on movement. An operation was performed four days later. On exposing the periosteum on the inner side and incising it, a brown coloured 'jam-like' looking mass was seen to lie immediately underneath. The cavity containing this pulp was scraped out with a sharp spoon, and two samples of the contents were taken for microscopic examination. The cavity measured about two inches in diameter, and was egg-shaped. A strong

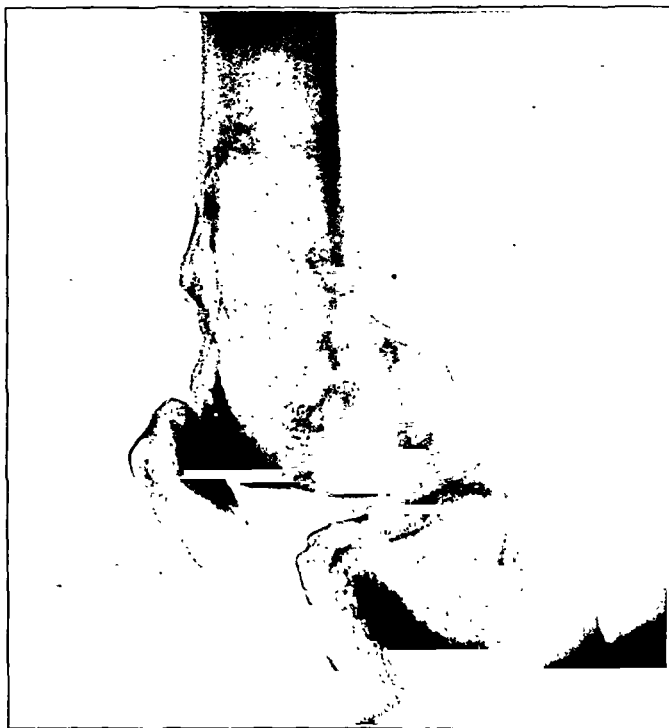


FIG. 138.—*Case 3.* Myeloma of femur. Seven months after operation.

solution of biniodide of mercury was used to kill any cells that might remain. The periosteum was then sutured and the wound closed. Microscopic examination proved the growth to be a typical-celled myeloma.

The patient was fitted with a caliper which he wore for four months. His recovery was so complete that in February, 1926, when he was asked to show his scar, he uncovered the wrong leg.

The last three cases show conclusively that the best way of treating myeloma of bone when it is imperative to prevent shortening, as is usually the case with the lower limb, is by very carefully shelling out the growth. They also show that the best way of treating the resulting bone cavity is by closing the wound completely and letting the cavity fill with blood: spontaneous

ossification usually takes place, with complete restoration of function. It is, of course, essential to prevent spontaneous fracture and to maintain the length of the limb and enable the patient to walk about; this can be done by means of a caliper splint, which is used for about six months after the operation.

Case 5.—R. W., a little boy, now 8 years old, was operated on for me by Mr. W. H. Ogilvie five years ago, when he was my surgical registrar. He has shown and discussed this case before the Royal Society of Medicine.² It was a case of osteitis fibrosa of nearly the whole of the shaft of the right humerus (*Fig. 139*).

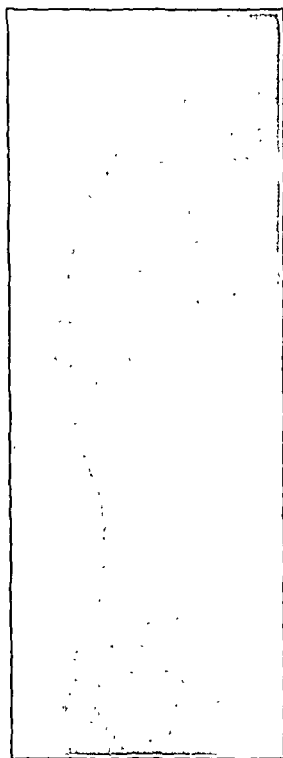


FIG. 139.—*Case 5.* Fibro-cystic disease of the right humerus. Before operation. Practically the whole of the shaft was excised.

After a preliminary exploration and microscopic examination establishing the diagnosis, Mr. Ogilvie removed nearly the whole of the shaft of the humerus subperiosteally. The immediate insertion of an autogenous bone-graft, which had been contemplated, had to be abandoned because the little boy was too exhausted for further prolongation of the operation. This proved to be very fortunate, for it led us to an important discovery, namely, that the graft was unnecessary, for the cavity in the arm filled at first with blood and then very rapidly with bone.

Two months later the boy was able to use his right arm freely and to raise his right hand to the normal extent above his head. He made a rapid and complete recovery. He was radiographed in February, 1926, by Dr. J. M. Redding (*Fig. 140*), who reported: "Complete ossification of the humerus. Comparatively slight deformity; slight shortening. No evidence of recurrence of disease". Even the central canal of the humerus had been restored.

The result was, in fact, as good as, if not better than, that of a very successful case shown by Mr. Gordon Bryan³ in which he had used a boiled beef-bone graft. If a graft is unnecessary, it is clearly better to do without it, for grafts may give rise to many troubles and some dangers: amongst these may be mentioned spontaneous fracture of the graft or of the parent bone, necrosis, sinus formation and imperfect union.

I have successfully used the same simple method for filling other large aseptic bone cavities, such as those resulting from simple cysts. Some infected cavities have been similarly treated with success, after taking pains to clean them before, or by excising their walls during, the operation. Infection of bone is, however, very difficult to eradicate.

Since the lecture of which this paper is an abstract was delivered at Guy's Hospital, on Feb. 11, 1926, an excellent paper by Major J. B. Hance, I.M.S., has appeared in the January number of the *Guy's Hospital Reports* which reached me on Feb. 24. Major Hance refers to Mr. Alan Todd's⁴ brilliant case

reported in the *Proceedings of the Royal Society of Medicine* (Clinical Section). In these papers autogenous cancellous grafting of the cavities is strongly recommended. My experience proves that grafting is superfluous, although it may possibly secure more rapid ossification.

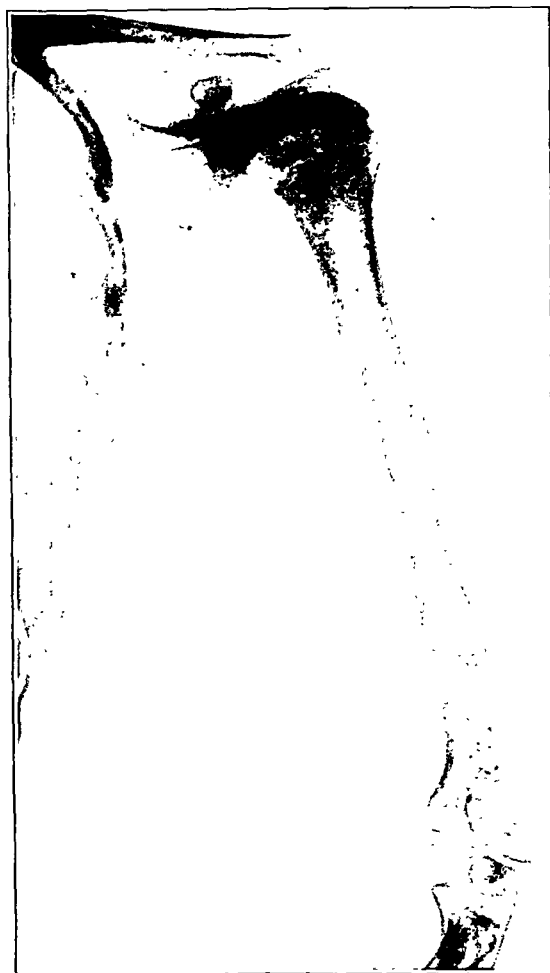


FIG. 140.—Case 5. Fibrocystic disease of right humerus. After operation. Note re-formation of the shaft of the humerus without bone-grafting.

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URINARY CALCULI COMPOSED OF BACTERIA.

By R. OGIER WARD, LONDON.

SOFT 'stones' formed in the urinary system are exceedingly rare. In some instances they are composed of fibrin; Gage and Beal¹ collected a series of these in 1908, and Thomson-Walker² describes a case. Such masses are soft, of greyish colour, and are composed of layers of fibrin with perhaps a few crystals among them, and one view of their nature is that they represent that organic material which is thought to cement together the crystallized portions of ordinary urinary calculi—or, in other words, that they are the mortar without the bricks; whilst another supposition is that they are formed from retained blood-clots, the fibrin of which has become moulded into regular masses. But the calculi here described belong to another and even rarer variety of soft 'stones', namely, those which are composed entirely of bacteria. J. and W. Israel³ mention these in their recent book, giving

references to four writers, and these are the only other cases of which I can learn. The concretions are described by these writers as "soft elastic bodies varying in size from a bean to a cherry; they are round or oval, or tetrahedraform in shape, and are composed entirely of coli bacteria".

A patient with this disease has recently been under my care. She was a female, age 35, who had suffered in the past from malaria, typhoid fever, and a tendency to diarrhoea. She was stated to have had many attacks of toxæmia and was exceedingly neurotic. Fifteen months previously she had a severe right renal colic, this being the first intimation of any urinary disorder; hæma-

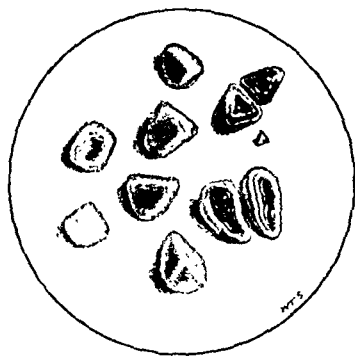


FIG. 141.—Some of the soft calculi passed.

turia accompanied the colic and lasted for a month, the urine being usually claret-coloured. At the end of the month she had another severe colic on the same side, and this was followed by acute renal infection, the temperature often going above 104°. About this time she was X-rayed, and one calculus was discovered which was judged small enough to be passed. About a month later—that is, three months from the onset of symptoms—there occurred several milder attacks of colic during which some small soft 'stones' (Fig. 141) were passed. Subsequently, after a more severe attack, the calculus seen on X-ray examination was got rid of, together with three of the softer variety. Throughout the subsequent ten months there were many attacks of right renal colic and nearly a hundred soft 'stones' were passed.

A pyelogram carried out by Dr. Rolfe Kingsley in New York showed the right kidney to be dropped and the ureter kinked directly below the pelvis, which seemed enlarged. The opaque fluid was dispersed throughout the pelvis by the presence of the stones. Pyuria persisted, but for various reasons operation had to be postponed. Some months later, however, there was another acute attack of obstruction and inflammation of the right kidney. I removed the right kidney and the calculi which it contained. The urine shortly before this attack had much pus in it, a few red blood-cells, and some transitional epithelial cells, whilst on culture a pure and abundant growth of *Bacillus coli communis* was obtained. The patient recovered from the operation, and all pyuria ceased at once, although three weeks later the organisms could still be cultured.



FIG. 142.—Showing the dilatation of the renal pelvis and the kinked ureter.

Fig. 142 shows that the renal pelvis is moderately dilated, and the kink of the ureter, which was demonstrated by pyelography, can also be seen.

Fig. 143 depicts the interior of the kidney after the highly purulent urine and most of the calculi—of which it contained over a hundred—had been removed. The extent of the hydronephrosis, and manner in which the concretions were distributed throughout the dilated calices, is well seen: whilst the report by Mr. G. L. Keynes which follows describes the microscopical appearances.

Section of one Pyramid and Corresponding Cortex shows: (1) Dilatation of all the tubules. (2) Hyaline degeneration of some of the glomeruli.



FIG. 143.—Interior of kidney after the removal of most of the calculi.

(3) Infiltration of the interstitial tissue in

certain segments, from apex of pyramid to cortex, with large numbers of leucocytes; in the cortex the appearance suggests that small abscesses are beginning to form. (4) Some of the collecting tubules contain casts formed of leucocytes.

The microscopic appearances indicate: (1) Chronic nephritis; (2) Hydro-nephrosis; (3) An acute ascending infection of the whole kidney.

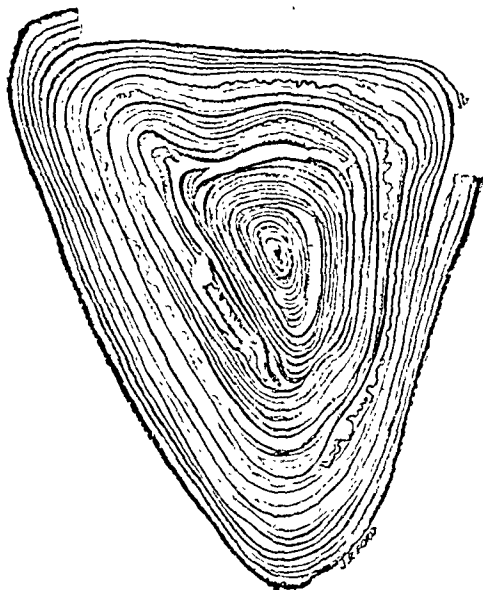


FIG. 144.—Magnified cross-section of one of the concretions.

Fig. 144, which is a magnified cross-section of one of the concretions stained by a silver process by Dr. F. W. Twort, shows its laminated structure, and that the external surface of each layer is most darkly coloured.

When this is compared with Fig. 145, which is a more highly magnified view of the darkly coloured outer part of one of the laminae, it becomes obvious that the 'stones' are composed almost entirely of bacteria, which are more degenerate towards the internal parts of each lamella, and here more feebly take the basic aniline dyes.

Dr. H. E. Archer's report details the chemical analysis and correlates this with the microscopical appearances described by Dr. Twort:—

Small tetrahedraform faceted calculi. Colour varying between grey-brown and grey. Surface smooth. The majority have a superficial white coat of 'fibrinous' material. Some calculi appeared to have a minute white nucleus.

				For one calculus.
6 average calculi weighed	0.5135	gram.	..	0.0856
" " " dried weight	0.1275	"	..	0.0212
" " " ashed weight	0.0291	"	..	0.005
" " " extracted with ether yielded	a minute amount			
of lipoidal matter which gave a very definite reaction for cholesterol,				
probably derived from blood (which normally contains about				
0.16 per cent).				

Chemical examination of ash showed: calcium; phosphate; sodium and magnesium (trace); iron (trace); chloride (trace).

Prolonged peptic and tryptic digestion had practically no effect upon the organic matter of the calculus. This indicated that the material is probably not fibrin.

Conclusions.—Comparing the chemical findings with the microscopical sections, the central portion appears to be the remains of a minute blood-clot, and the outer layers to consist of bacteria and organic debris with a small amount of calcium and magnesium salts.

The cementing layers appear to be of a mucoid nature.

It remains only to make a few comments on the case. There was a history of bowel disorder which may have been the source of the infection

of the urinary tract; and the ureteropelvic kink and ptosis, by producing stasis in the right kidney, was probably the factor which determined its localization in that organ. The writer cannot, however, offer any explanation of the special conditions which obtained in the case, and which caused the bacteria to cohere and to form these very numerous concretions (for there were in all more than two hundred of them), whilst in other patients infected with the same organism only a bacilluria or a urinary infection results. Presumably the mucinous cement material is the factor essential for cohesion. Nor is it certain whether the 'stones' were all formed at one time or were being continually produced, though the laminated appearance favours the latter suggestion.

The diagnosis of such a case is unlikely to present any special difficulties, for the 'stones' are so soft and elastic that some are sure to be passed, when a careful examination will reveal their nature. A radiogram by Dr. N. S. Finzi,

using the Potter-Bucky diaphragm, showed their outline shadows very faintly, but a pyclogram will probably always be necessary to make this obvious.

As to treatment, in the case here described nephrectomy was essential because a pyonephrosis was forming, but in other instances it might be advisable to postpone this if there were reason to think that the calculi were being discharged from the kidney and others were not forming, for their soft elastic nature renders their passage along the ureter much more easily effected than is the case with the common varieties of calculi.

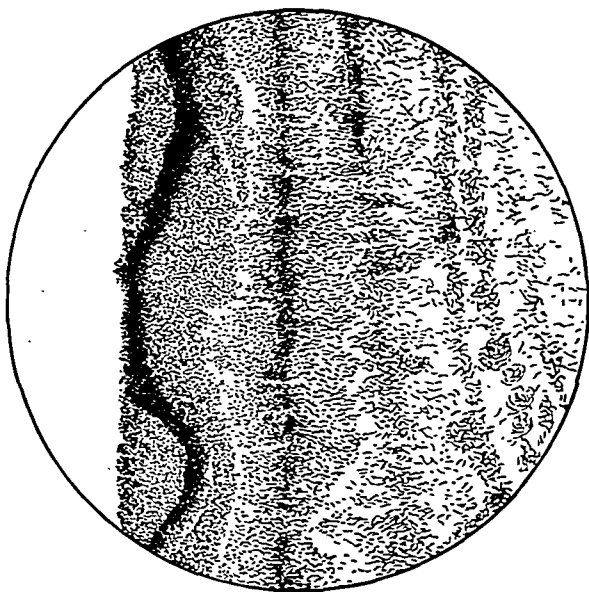


FIG. 145.—More highly magnified view of outer part of one of the laminae.

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TUBERCULOSIS OF THE MALE BREAST.

BY R. H. JOCELYN SWAN AND H. J. B. FRY, LONDON.

TUBERCULOSIS of the male breast must be accounted a pathological curiosity, for not more than eleven cases have been recorded in the literature since tuberculosis of the breast was first described nearly a century ago.* The present forms the twelfth of the published cases, several of which, however, cannot be regarded as definite from a pathological standpoint. Indeed, it is a remarkable fact that, in spite of the widespread prevalence of tuberculosis in its various forms, tuberculous infection of the breast, even in the female, is a rare condition. Fewer than two hundred cases have been reported in all, including the male cases. In published collections of tumours of the breast they form not more than 0.5 to 1 per cent. The records of the Cancer Hospital for the last quarter of a century have been searched; and in this series not previously reported, out of 2542 tumours of the breast of all kinds, there have been 10 cases of tuberculosis of the breast, including the male case reported here, all of which have been verified by microscopical examination. This gives a percentage of 0.4 for this series, in which the only male case during this period of twenty-five years is the present one.

CLINICAL NOTES OF THE CASE.

F. P., age 42, chauffeur. Admitted May 20, 1924, under Mr. Jocelyn Swan.

HISTORY.—The patient complained of a swelling in the left breast which he had noticed for three months. This had become gradually larger, and during the last month there had commenced some retraction of the nipple. The swelling was not painful, but pressure on it caused discomfort. In 1900, twenty-four years previously, the patient was operated upon for tuberculosis of the right hip-joint, which was ankylosed. There was no history of other illness.

ON ADMISSION.—The patient appeared healthy, and was well nourished. There was a rounded, hard, somewhat nodular swelling in the region of the left breast about two inches in diameter; it was fixed to the subjacent pectoral muscle and the nipple was slightly retracted; the skin of the areola and of the part immediately surrounding the latter was thickened and adherent to the mass, but there was neither redness nor œdema. Several small glands were palpable in the left axilla. A diagnosis of carcinoma of the breast was made, itself a somewhat rare condition in the male.

OPERATION.—Radical removal of the breast was advised and carried out on May 24, 1924. An incision was made from the left side of the umbilicus

* Since the above was written one more case has recently been described by Turco.¹⁵

obliquely upwards across the costal margin and the pectoral region internal to the anterior fold of the axilla and crossing the anterior fibres of the deltoid muscle, joined in the central part by another incision which enclosed an elliptical area of skin around the tumour in the breast. Skin and fascial flaps were turned back, and the whole breast was removed, together with the sternocostal portion of the pectoralis major muscle, the pectoralis minor, the upper aponeurosis of the rectus muscle, and the fascia covering the serratus magnus and the contents of the axilla, the axillary vein being cleaned as high as the costocoracoid membrane. The wound healed without trouble and the patient made a complete recovery.

PATHOLOGICAL EXAMINATION.—When examined in the laboratory the breast was found to contain an abscess cavity immediately beneath the nipple in the fatty areolar tissue between the pectoralis major and the skin. The cavity was irregular in shape, lined by a thick wall of yellowish caseous granulation tissue, and limited by an outer layer of hyaline fibrous tissue (*Fig. 146*). A small quantity of rather thick yellow pus was evacuated on opening the cavity. On examination this pus showed a considerable number of acid-fast bacilli, morphologically typical tubercle bacilli. No other organisms were found.

Histological examination of the breast tissue showed an abscess cavity limited by a thick wall of fibrous tissue penetrated by chronic inflammatory cells (*Fig. 147*). The cavity was lined by granulation tissue, and contained acute and chronic inflammatory cells, connective-tissue cells, and fibroblasts in various stages of fatty degeneration and disintegration. Numerous plasma cells were present, with many polymorphonuclear cells and patches of red cells. Small giant cells were present in the wall of the abscess (*Fig. 148*). No fat necrosis was evident either in the abscess or in the neighbouring breast tissue. An adjacent lymph gland showed no tubercles, and, in fact, no marked pathological changes. In view of the positive character of the bacilli in the pus and of the histological appearances, animal inoculation was not performed.

Subsequent to this pathological finding, the patient was subjected to a further critical examination to discover other evidence of tuberculous disease. Mention has already been made of the previous tuberculous hip-joint, ankylosed after an operation twenty-four years previously, but no evidence was obtained of any pulmonary infection and no tubercle bacilli could be found in the sputum. Small hard nodules were found in the epididymis on both sides, and one was also found in the upper part of the right lobe of the prostate. In the absence of any history of venereal disease, these were looked upon as old foci of tuberculous infection, but no other suspicious lesions could be found.



FIG. 146.—Tuberculous abscess in the male breast.

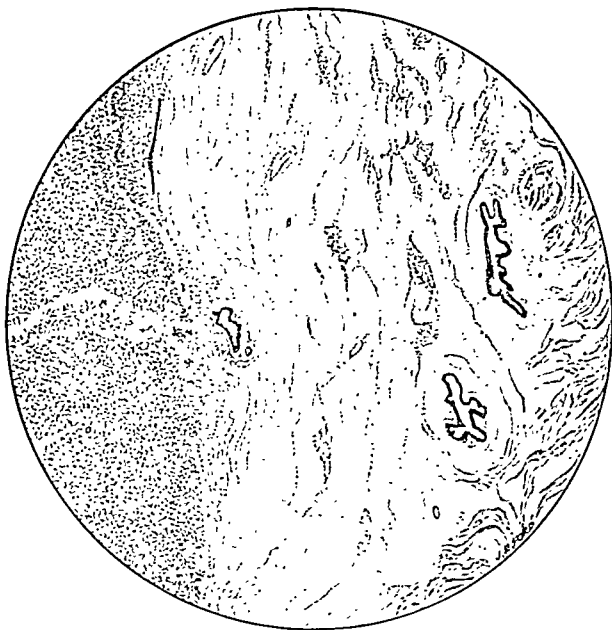


FIG. 147.—Photomicrograph of wall of tuberculous abscess. ($\times 20$.)

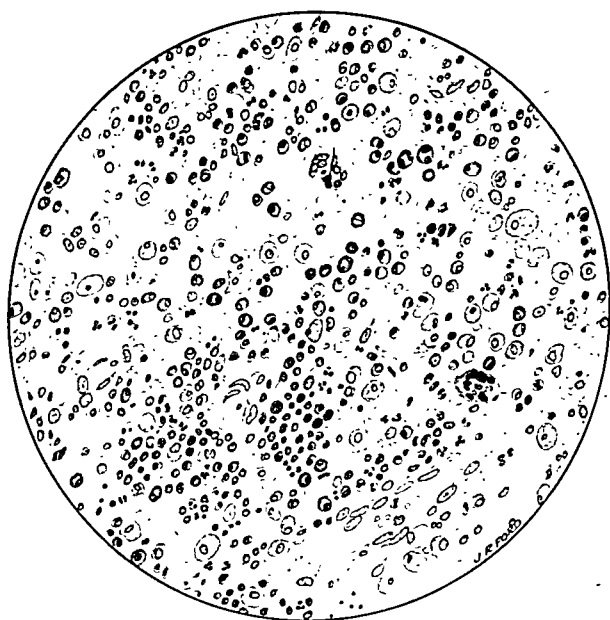


FIG. 148.—Photomicrograph of tuberculous abscess showing cellular contents. ($\times 135$.)

HISTORICAL.

Tuberculosis of the breast was first described by Sir Astley Cooper¹ in 1829, the earliest case in the male being reported by Heyfelder² in 1851. No microscopical or bacteriological proof is available in this case, so that its nature remains open to doubt, and it was therefore rejected by Scudder.³ From the clinical description, however, it seems probable that Heyfelder's case was tuberculous in nature. The first case in the male in which tubercle bacilli were demonstrated seems to be the one by Schede⁴ in 1893. Other cases in the male have been reported by Poirier,⁵ Demme,⁶ Delbet,⁷ Ferguson,⁸ Hebb,⁹ Parsons,¹⁰ Khesin,¹¹ Ressiguie,¹² and the last, in 1916, by Durante and MacCarty.¹³ Of these only seven have been definitely proved by satisfactory pathological and bacteriological findings, viz., those of Poirier, Schede, Hebb, Demme, Khesin, Ressiguie, and Durante and MacCarty. The case quoted by Delbet was an oral communication by Thierry, without any published details, and is therefore a matter of conjecture only. The cases of Schede and Ferguson are practically devoid of details.

ANALYSIS OF CASES.

Incidence.—The remarkably small number of cases described in the male, ranging over a period of nearly one hundred years since the condition was first described, clearly indicates the rarity of this infection. It forms, indeed, less than 0.05 per cent of all breast cases. In the Cancer Hospital series the percentage is 0.04, which accords well with the proportion of published male and female cases. This is of some interest when considered in relation to the general incidence of tuberculosis in other forms in the male and calls for some explanation of its pathology.

Predisposing Causes.—

1. *Age.*—The common period appears to be the third and fourth decades of life, and all but five of the cases can be included in this period, a remarkable exception being the case described by Demme⁶ of direct infection in an infant of 6 months. The oldest case recorded is 52.

2. *Heredity.*—Evidence of an hereditary susceptibility has been found in only one of the cases recorded (Demme).

3. *Antecedent Injury or Disease.*—In two instances there was a history of injury followed by the tumour, and in another a previous abscess, but in the majority of cases this does not appear to influence the condition.

Classification.—Tuberculosis of the breast has been divided into two groups, primary and secondary. The former comprises the cases in which there is not elsewhere a demonstrable tuberculous infection from which the lesion of the breast can be derived. Infection is, therefore, considered to be primary when it occurs either directly through the skin of the breast or through the ducts of the nipple, or if conveyed to the breast through the blood-stream from a remote portal of entry. In this series only four cases can be considered to be primary, in one alone of which is there evidence of direct infection (Demme). In two cases the evidence is insufficient as to the mode of infection. In six cases the infection of the breast was secondary to foci of the disease elsewhere. This is evidently the commonest form. In two cases

there was a history of joint tuberculosis (Khesin, Swan and Fry); two were due to osteitis of the ribs (Parsons, Ferguson); one to tuberculous lymphatic glands (Heyfelder); and one to pulmonary tuberculosis (Durante and MacCarty). The channels of infection were, therefore: (1) By the blood-stream; (2) By direct extension; (3) By lymphatic channels.

Types.—Various pathological types of tuberculous disease of the breast are described, namely: (1) Acute miliary tuberculous mastitis; (2) Nodular type; (3) Sclerosing type; (4) Mastitis obliterans.

In the male, only the nodular variety appears to have any place, especially the form of the intraglandular cold abscess of Roux, which is derived by a process of caseation and liquefaction from the nodular variety. In five of the published cases there was formation of abscesses of varying size. In Heyfelder's case the abscess extended from the acromion process to the lower border of the nipple; in others it was of small size. In the case described here the typical glandular cold abscess is shown in *Fig. 146*. The nodular type was present in five other cases in which a small lump was felt in the breast.

Bacteriology.—The condition can only be recognized with certainty by the finding of tubercle bacilli in the tissues or in the pus of the abscesses, by cultivation from pus, or by animal inoculation in suspected cases. In only three cases out of the twelve has this condition been fulfilled (Schede, Demme, Swan and Fry). The practical difficulty of finding scanty tubercle bacilli in tissues may account for this. In the case described here tubercle bacilli were numerous in the pus of the abscess. In only one of the cases has animal inoculation been practised.

Microscopic Anatomy.—In six out of the twelve cases the diagnosis rests upon microscopical appearances apart from the finding of tubercle bacilli. In

SUMMARY OF REPORTED CASES

Reporter	HEYFELDER	POIRIER	DEMME	DELBET	HEFF
Year ..	1851	1882	1889	1892	1893
Age ..	26	46	6 months	—	31
Occupation	Shoemaker	Road labourer	—	—	Gas-stoker
Heredity ..	—	Nil	Active pulmonary tuberculosis in mother and sister	—	Negative
Antecedent Condition of Breast	—	Blow in this region 2 years previously	—	—	Injury 8 months previously
Type ..	Secondary	Primary	Primary	—	Primary
Initial Symptoms	Lump	Two vesicular nodules; indurated bases	Swelling and abscess	—	Lump following injury

most of these typical tubercles were found, with a greater or lesser degree of fibrosis, caseation, and necrosis, together with giant cells and chronic inflammatory cells. It must be remembered, however, that the condition of fat necrosis in the breast first described by Lee and Adair¹⁴ may give rise to somewhat similar appearances, and care must be taken to distinguish the latter from tuberculous disease. Possibly some of the cases recorded may have been due to fat necrosis.

Symptoms.—The course of the disease is rapid in the male—not more than three to six months, and shorter than in the female. This is evidently due to the greater ease with which a small lump is recognized in the rudimentary male breast, and treatment more rapidly instituted.

Early symptoms: In at least half of the cases the initial symptom was the discovery of a lump in the breast. In only two cases was there pain connected with it. *Side:* the distribution between the two sides is about equal, four being in the right breast and five in the left, the remainder not being recorded. In the female the right is more often affected than the left side. The *site* is usually in the neighbourhood of the nipple—this was the position in four cases; in the lower quadrant, one; outer and inner sides, one each. In the female it is more generally the upper and outer quadrant which is affected. The skin was adherent in four of the cases where this was noted, and showed some inflammation in four. The nipple was retracted in two of the cases in which an abscess lay beneath it, but there was no discharge from the nipple in any. Axillary glands were enlarged in two of the cases. Sinuses were present in only one of the cases (Demme). The general condition of the patient appears to have been good in most instances, though the physique was poor in two.

TUBERCULOSIS OF THE MALE BREAST.

GIBSON	PARSONS	KHESIN	RESSIGUE	DURANTE AND MACCARTY	SWAN AND FRY	TURCO
898	1907	1909	1909	1916	1925	1925
—	38	23	40	52	42	23
—	Labourer	—	—	—	Chauffeur	Warehouseman
—	—	—	—	—	Negative	Negative
—	—	—	Abscess 2 years pre- viously	—	Healthy	Anti-typhoid inoculations
Secondary in rib	Secondary	Secondary	Primary	Secondary	Secondary	Primary
—	Lump	Lump	Lump	Abscess	Lump	Lump

Continued on next page

SUMMARY OF REPORTED CASES

Reporter	HEYFELDER	POINIER	DEMME	DELBET	HEBB	ST
Location ..	Above nipple	3 cm. outside nipple	—	—	Inner side	—
Duration ..	2 months	3 months	From age of 4 days	—	6 months	—
Size ..	Acromion to right border of sternum, below to the nipple	6 × 4 cm., oval	2.5 cm.	—	Small hen's egg	—
Side ..	Right	Right	Left	—	Left	—
Pain ..	—	Present 3 weeks	—	—	None	—
Attachment to Skin	Not adherent	Adherent; not to pectoralis major	Adherent	—	Not adherent to skin; slightly to muscle	—
Sinuses ..	—	No	Present	—	—	—
Nipple Retraction	—	No, but thickened	—	—	—	—
Axillary Glands	—	Affected	Affected	—	—	—
General Health	Poor physique	Good	Poor	—	—	—
General Examination	Swollen glands in neck with scars	No pulmonary or other signs of tuberculosis	—	—	—	—
Treatment	Incision 2 in. and drainage	Excision, with axillary glands; muscle left	Ulcer scraped; iodoform dressing	—	Excision with removal of muscle	—
Result ..	Complete recovery	Uninterrupted recovery	Recovery	—	—	—
Pathology ..	—	Tubercle	Tubercle	—	Tubercle	—
T.B. found	—	—	Yes	—	—	—
Animal Inoculation	—	—	Positive	—	—	—

TUBERCULOSIS OF THE MALE BREAST—*continued.*

HUSON	PARSONS	KHESIN	RESSIGUE	DURANTE AND MACCARTY	SWAN AND FRY	TURCO
—	Under nipple	—	Near nipple	Lower quadrant	Under nipple	Upper inner quad- rant
—	3 months	—	3 months	—	3 months	3 years
—	4 × 5 × 1½ in.	—	Horse- chestnut	—	2 in. diameter	Half a hen's egg
—	Left	Right	Right	Left	Left	Left
—	Present	Present	At times	—	None	Present
—	Abscess adher- ent to super- ficial and deep structures	—	—	Slight in- flammation	Adherent to skin and muscle	Lightly adherent to skin and to deep structures. Skin never red- dened
—	—	—	—	—	Absent	None
—	Yes	—	—	—	Yes	Yes
—	—	Affected	—	—	Affected	Affected
—	—	—	Good	Poor	Good	Poor
reulo- of rib	—	Antecedent joint tuber- culosis	Negative	Pulmonary tuberculo- sis, empy- ema left side	Ankylosed tuber- culous right hip; tuberculous no- dules in epidid- ymes and right lobe of prostate	No other evidence of tuberculosis
pated deal- with	Amputation of breast and part of pecto- ralis major; rib scraped	Amputation and clear- ing of axilla	Amputation with remo- val of pecto- ralis major	—	Radical excision	Amputation with partial removal of pectoral mus- cles and clearing of axilla
—	Uninterrupted recovery	—	—	—	Good	Excellent
—	Cascating tu- berculous mat- erial (naked eye)	Tubercle	Tubercle	Tubercle	Abscess cavity; giant-cell sys- tems	Abscess cavities; giant-cell sys- tems
—	—	—	—	—	Yes	—
—	—	—	—	—	—	—

Differential Diagnosis.—This lies between the following conditions:—

1. *Ordinary Pyogenic Mastitis and Abscess.*—The greater chronicity of the tuberculous condition, the freedom from pain, and the absence of acute inflammation afford some indication. The pyogenic cases can probably be settled by bacteriological methods.

2. *Granulomata.*—Actinomycosis of the breast is rare and tends to the formation of sinuses, in the pus from which the ray-fungus can be found. Syphilitic conditions, such as gummata of the breast, are equally rare, and probably could not be distinguished except by a positive Wassermann reaction and by microscopical examination.

3. *Tumours*, whether simple or malignant, such as the fibro-adenomata or carcinomata of the male breast, are rare, but cannot easily be distinguished from a tuberculous infection except by microscopical methods.

4. *Fat necrosis* is also a condition which closely simulates both tuberculous and malignant disease (Lee and Adair¹⁴), and would require microscopical diagnosis.

Prognosis.—This appears to be uniformly good. In all cases recovery after surgical treatment was satisfactory.

Treatment.—Radical excision of the breast seems to be the method chiefly practised, together with removal of all tissues involved, with or without clearing of the axilla. Incision and drainage has also proved effective. Treatment, no doubt, would depend on correct diagnosis, which is not easy to determine prior to operative measures.

CONCLUSIONS.

Tuberculosis of the breast in the male is a very rare condition. In consequence of its rarity and from its nature it is difficult to diagnose and may easily be mistaken for carcinoma. Its rarity is probably due to the small size, rudimentary character, and absence of functional activity in the male breast, with its concomitant lack of vascular and lymphatic circulation:

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SPRENGEL'S DEFORMITY WITH PARAPLEGIA.

By MACDONALD CRITCHLEY, LONDON.

CONGENITAL elevation of the scapula, as described by Eulenburg, and later by Sprengel, is by no means common. The present case is of particular interest in that the subject is an adult, and has been under observation for sixteen years. The association of the scapular deformity with other bony defects in the skeleton is of interest—though not rare. The co-existence of a paraplegia with Sprengel's deformity, however, renders the case unique. The causation of the paraplegia is not clear, and a discussion as to the pathogenesis entails speculations of great importance.

DESCRIPTION OF THE CASE.

F. L., age 45, a carman, was admitted to the National Hospital, Queen Square, under the care of Dr. James Collier. His chief complaint was of stiffness in the left leg and difficulty in walking.



FIG. 149.—Front view of patient. Note the drooping of the affected shoulder. The facial asymmetry is quite apparent.

He stated that ever since the age of 2 years a deformity of the left shoulder and neck had been present, so that his left arm was weak and could not be raised above his head. Except for occasional darting pains in the shoulders and limbs, he remained well until the age of 30, when, in a drunken brawl, his arms were twisted behind his back. He felt a severe pain in the thorax, and both legs became numb and useless. The weakness in the legs had persisted ever since, accom-



FIG. 150.—Photograph illustrating the left-sided hemiatrophy and scoliosis; the tilted attitude of the head is well shown. The contour of the spinous processes and of the left scapula have been marked out with ink.

panied by numbness and dull aching in the right leg. About three years before admission he began to have feelings of stiffness in the left leg, and aching pains in the left chest. No sphincter troubles

had ever been present. Apart from an attack of scarlet fever, and also of gonorrhœa at the age of 20, his previous health had been good. Syphilis was denied.

His parents were healthy and his six brothers and one sister were alive and well. The patient was a single man and had no children. There was no history obtainable of any similar deformity amongst the other members of the family.

Physical Examination.—The patient was a man about 5 ft. 2 in. in height. His build was remarkable in that he appeared to have scarcely any neck at all. The left side of the head was tilted down towards the shoulder. The interval between the right side of the occiput and the back of the trunk was occupied by a prominence which was felt to consist of scoliotic cervical vertebræ. The right shoulder blade lay at a higher level than the left, and could be felt to be elevated and rotated upwards, so that the vertebral border lay under the trapezius. There was a very sharp angular scoliosis of the cervical and upper thoracic vertebræ, the apex of the gibus being to the right. (*Figs. 149–152.*) The angles of the ribs were somewhat more prominent on the right side, whilst the left half of the chest bulged in front. The left arm and leg were seen to be a little smaller in girth than the right, though the left leg was a little longer.

DIMENSIONS.

			Right.	Left.
Circumference of upper arm	..	..	10½ in.	10½ in.
Length of forearms	..	..	10 "	9½ "
Circumference of forearms	..	..	10 "	9½ "
Circumference of hand (around knuckles)	..	..	8 "	7½ "
Length of legs (from anterior superior iliac spine to tip of external malleolus)	..	..	33 "	34½ "
Circumference of thighs	..	..	18 "	19½ "
Circumference of calf	..	..	13 "	12 "

The left foot was a little longer, but somewhat narrower, than the right.

CENTRAL NERVOUS SYSTEM.—No disturbance of mentality was noted. Speech was normal. There was a slight but obvious facial asymmetry, the left half being a little smaller than the right. The palpebral fissures were unequal, and there was a condition of heterochromia iridum present, the left iris being a deeper blue than the right.

Motor System.—Patient was right-handed. The left arm and hand were smaller in all dimensions, but there was no localized muscular wasting. The patient could not abduct his left arm beyond 45°, and internal and external rotation movements were limited. All other movements were possible, but were somewhat weaker on the left side than on the right. There was no disorder of tonus or co-ordination. No involuntary movements were present.

Trunk.—The recti abdominis contracted well, and there was no deviation of the umbilicus on attempting to sit up.

Legs.—The left leg was a little longer than the right, and was held in an attitude of extension and internal rotation. There was some inversion of the left foot. The muscles of the left leg were flabbier and less bulky than those of the right. All movements were possible in both legs, but the left



FIGS. 151 and 152.—Two skiagrams showing the cervico-dorsal torticollis and the characteristic Sprengel's deformity of the left scapula. The irregularity in the outline of the ribs is just visible. The skiagrams are reversed.

leg was relatively weaker than the right. Co-ordination was normal. There were no involuntary movements.

There was no disturbance of tone in the right leg, but there was a definite rigidity of the clasp-knife type in the left leg, which tended to wear off after repeated manipulations.

Sensory System (Fig. 153).—Cotton-wool was appreciated normally everywhere; appreciation of pinprick was diminished over the whole of the right leg and the right side of the trunk up to the level of the 8th thoracic segment. Above this level, and up to the level of the 4th thoracic segment, pinprick was felt more plainly, but still not as well as on the left side

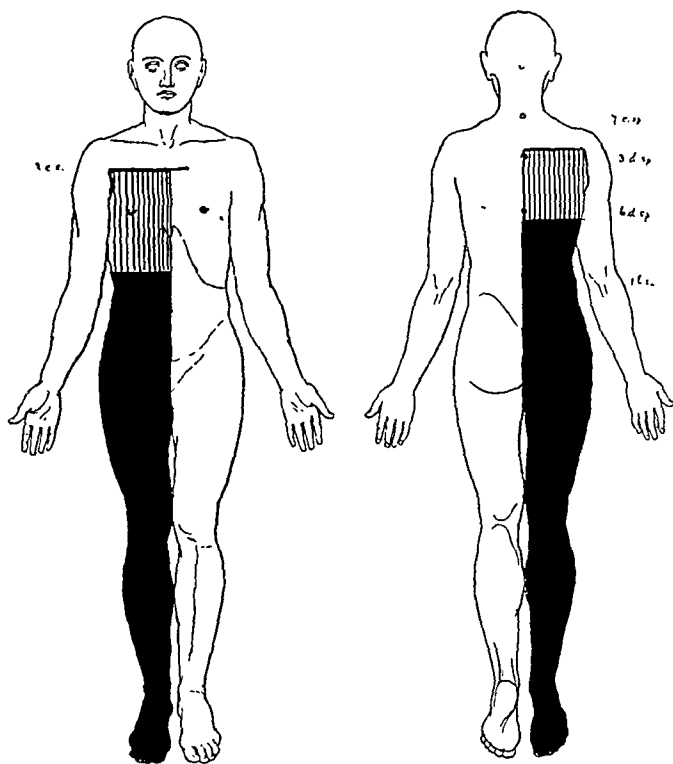


FIG. 153.—Sensory chart indicating area of diminution to heat, cold, and pinprick. There is no loss to light touch.

of the body. Above the level of the 4th thoracic segment, sensation was normal. Hot and cold objects were appreciated less acutely over the same areas in which pinprick was diminished. Postural sensibility was defective in the toes and ankles of both feet. A vibrating tuning-fork was felt as such at the left external malleolus, but not on the right side. There was astereognosis in both hands.

Reflexes.—All the tendon-jerks were present, but were exaggerated on the left side. The abdominal reflexes were absent, and plantar stimulation evoked an extensor response on both sides. Ankle-clonus was obtainable on the left side. There was no disorder of sphincter control.

The Gait.—This was slow and spastic; the left knee was kept extended, the left side of the pelvis was raised, and the left leg circumducted forwards with each step.

No abnormality was detected in the alimentary, respiratory, or cardiovascular systems. Urinalysis was normal.

Examination of the cerebrospinal fluid (Dr. J. G. Greenfield) was as follows: Clear, colourless fluid; cells, 1 per c.mm.; total protein, 0.015 per cent; Nonne-Apelt test, negative; Pandey's test, negative; Lange, 000000000; Wassermann, negative.

COMMENT.

The case is that of a man of 45, who exhibits a Sprengel's deformity of the left shoulder, together with marked cervical scoliosis and wry-neck. For the past fifteen years he has been subject to weakness, numbness, and pains in the legs, without any disturbance of the sphincters. Examination reveals a condition of paraplegia, the weakness and spasticity being confined to the left side, whilst a hypalgesia to painful and thermal stimuli is obtained on the right side as high as the 4th thoracic segment. Examination of the cerebrospinal fluid precludes any state of spinal-cord compression.

Speculation as to the causation of the paraplegic manifestations in this case raises questions of the utmost interest. Two main possibilities at once present themselves: on the one hand, the paraplegia may be the mechanical result of distortion and traction of the spinal cord and roots by the angular scoliosis; on the other hand, the neurological manifestations may be the result of a coincident congenital intramedullary anomaly of the nature of syringomyelic cavitation.

In considering the former possibility, the rarity of scoliotic paraplegia must be emphasized. Potts, in his original communication on spinal curvature, made the statement that paralytic signs appear only when the curvature is antero-posterior in direction. This generalization, however, is not strictly accurate. Although paraplegia is a rare sequel of extreme degrees of scoliosis, there are nevertheless cases on record in which the association is beyond question.

Thus Collier¹ showed before the Neurological Section of the Royal Society of Medicine a girl of 16 who, as the result of poliomyelitis at the age of 3, exhibited a severe scoliosis in the mid-dorsal region. Eighteen months before coming under observation her legs began to drag; ten months later flexor spasms appeared: and six months later still she lost bladder control. The girl was then in a state of severe spastic paraplegia in flexion, with a motor and sensory level as high as the 7th thoracic segment. The spinal fluid revealed a loculation or 'partial Froin's' syndrome. In his introductory remarks Collier stated that he had seen four other cases in which severe scoliosis from poliomyelitis had been followed years later by paraplegia.

Elmslie² demonstrated two similar cases before the Orthopædic Section of the Royal Society of Medicine. The first case was that of a boy of 18 who developed a spastic paraplegia in extension eight years after the appearance of a post-poliomyelitic scoliosis. There was a sensory loss up to

the level of the 5th thoracic segment. Lipiodol was held up in the spinal theca at the level of the 4th dorsal spine. Elmslie performed a laminectomy of the spines of the 3rd, 4th, 5th, and 6th vertebræ. The cord showed no abnormality beyond a marked degree of stretching. His second patient—a boy of 12—began to develop paralytic signs five years after the appearance of scoliosis. At the time of the demonstration the boy was in a state of spastic paraplegia in flexion. Lipiodol was held up opposite the body of the 1st dorsal vertebræ.

In the present case the symptoms in their full intensity have dated from the dispute in which the arms were twisted and wrenched behind the back. It is certain, however, that mild premonitory symptoms had been present for some years previously. It is conceivable, therefore, that this paraplegia is the result of a prolonged stretching of the cord, and more particularly of its roots in the distorted bony canal, the trauma being the precipitating etiological factor. Such a hypothesis would account for the motor and sensory defects in the legs and trunk. It is difficult, however, to explain the total left-sided hemiatrophy and the heterochromia iridum on such a hypothesis. The objective sensory changes on closer examination become more and more difficult to reconcile with a purely extramedullary lesion; the dissociation of the sensory loss over the right leg and trunk—though well known for many years as a temporary symptom of extramedullary lesions of the spinal cord—is known to have existed in this present case for at least fifteen years. Such a protracted dissociation favours rather an intramedullary origin. Again, the bilateral astereognosis is scarcely explicable on the hypothesis of a scoliotic paraplegia.

It is perhaps easier to explain the symptomatology of the present case by regarding the central nervous manifestations as syringomyelitic in nature. The paraplegia with bilateral extensor plantar responses, the dissociated hemianæsthesia, the bilateral astereognosis, favour such a diagnosis. The facial asymmetry may be the result of a lifelong torticollis, but a heterochromia iridum is almost certainly the result of a prolonged unilateral affection of the sympathetic, and is a manifestation not infrequently met with in syringomyelia. The marked aggravation of symptoms after an injury is a well-known phenomenon in this disease, and may be the result of a hæmorrhage into the syringomyelitic cavity.

The co-existence of syringomyelia with various skeletal anomalies, apart from the characteristic scoliosis and arthropathies, is well known. Thus, one has seen the disease associated with acromegaly (Macbride,³ Petré⁴), cervical ribs (Oppenheim, Marburg), and spina bifida (occulta and aperta). The disease has also been described associated with recurrent dislocation of the shoulder-joint (Schrader) and cheiromegaly (Charcot and Brissaud). As far as one has been able to trace, there is no recorded instance of an association between syringomyelia and Sprengel's deformity.

The case is also of additional interest in exhibiting, in common with most cases of Sprengel's deformity, other bony defects in the cervico-thoracic regions. As in the case recorded by Niederle⁵, there appears to be a reduction in the number of cervical vertebræ—the so-called Klippel-Feil syndrome. This would partly account for the apparent absence of a neck on inspection

of the patient. The marked torticollis and scoliosis have already been referred to. In Horwitz's⁶ series of 136 cases the former deformity was present in 10 per cent and the latter in 47 per cent of cases.

Deformity of the ribs is common in association with elevation of the scapula, and in this instance the second left rib is seen in the skiagram to be of unusual girth, and to articulate with the side of the head of the 3rd rib, while the 4th, 5th, and 6th ribs on the left side are of usual breadth and conformity (*see Figs. 151, 152*).

Unlike Neuhoﬀ,⁷ we have been unable to trace any evidence of an heredo-familial incidence in our patient. There is no sign, moreover, of an elevated scapula on the opposite side, although a bilateral Sprengel's deformity occurred in 11 out of Zesas's⁸ series of 99 cases.

I should like to thank Dr. Collier for his kindness in permitting me to record this case.

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THE RADICAL OPERATION FOR URETHRAL STRICTURE.

By R. HAMILTON RUSSELL, MELBOURNE, AUSTRALIA.

THERE is perhaps no human ailment that is the source, in the aggregate, of suffering so intense, prolonged, and hopeless as severe urethral stricture under treatment by dilatation; yet dilatation has seemed from time immemorial the best method of treatment that surgical science has been able to offer, and it has never been superseded, nor apparently even seriously challenged. "Dilatation first, dilatation always," has been accepted as the epigrammatic statement of a firmly-established principle governing the treatment of urethral stricture; while operative enterprise has been almost entirely occupied with procedures designed to facilitate or render possible subsequent treatment by dilatation.

There are various tubular channels in the body that are prone to become strictured, to the ruin of their function; but of these there is only one, the abdominal portion of the alimentary canal, that has seemed to lend itself to successful treatment by excision of the stricture with restoration of the continuity of the channel. The special features that have rendered this possible are, first, the *peculiar healing properties of apposed peritoneal surfaces*; secondly, the mobility and the size of the intestine. None of these attributes are possessed by the male urethra; hence it is not surprising that attempts to excise the stricture and unite the severed ends of the urethra over a catheter have never proved attractive to the large majority of surgeons, nor have the devices usually been of a nature to inspire confidence.

On the other hand, were it possible to devise some plan of excising urethral strictures that should be as straightforward and as certain as excision of an intestinal stricture, this would at once bring about a 'revolution' in the treatment of urethral stricture, and dilatation would be promptly brought down from its 'bad eminence' and would find only a relatively humble sphere of usefulness, very much in the background.

It is precisely this 'revolution' that has already taken place in the practice of a number of leading Australian surgeons, and it is in part the purpose of this paper to explain how it has come about, and upon what it is based. It means necessarily that some observations must have been made revealing attributes possessed by the male urethra which are as distinctive and favourable to the operation of excision as are those that are peculiar to the intestine; and this is so. Such attributes, however, must be entirely different in the two cases, for in dealing with the urethra we have no helpful peritoneum to aid us, and the deep urethra is anything rather than a mobile structure.

In the BRITISH JOURNAL OF SURGERY (1915, ii, 375) will be found the description of a method that I had found successful in the excision of urethral stricture, based upon a principle that seemed to me of great importance, and.

so far as I was aware, entirely new. One author alone, the writer in Binnie's *Operative Surgery* (1915), seems at once to have grasped its significance, stating that in his opinion "this operation promises to supersede all others," and giving an admirable condensed account of it that would seem to be all-sufficient as a guide to an experienced operator. But for this circumstance I should have reproached myself for having failed to make the essential principle of the operation as clear-cut as it can and should be made. My main object in this paper is to describe an amended and greatly simplified technique of the operation; and incidentally to call attention to the special qualities displayed by the urethra—qualities that are its peculiar possession, and which show it to be more richly endowed than even the intestine with attributes that favour the treatment of stricture by excision.

The Special Attributes possessed by the Male Urethra which favour the Treatment of a Stricture by Excision.—These are two: (1) The capacity for spontaneous restoration after it has been slit up, no matter to what extent. (2) The elasticity or extensibility, which is physiologically controlled, and enables the urethra to lengthen and shorten in response to changing conditions of the generative organs. I think I am safe in concluding that the possession of this attribute is highly favourable to us when we desire to sacrifice a short length of the urethra with a minimum of inconvenience. Neither of these singular attributes is possessed by any other tubular channel in the body; and their co-existence in the urethra implies an obligation to examine into means for making use of them.

The Capacity for Spontaneous Repair.—It is the capacity for spontaneous restoration after the slitting up of the urethra that affords the clue to a means by which a stricture may be excised. The 'how' and the 'why' of it is explained in a paragraph which I will transcribe from my earlier paper (loc. sup. cit.) :—

"The urethra when slit up is converted from a tube lined with mucous membrane into a 'riband' covered with mucous membrane; its restoration is to be left entirely to natural processes, and will depend upon the obvious fact that a strip of mucous membrane flanked on either side by raw tissues, which tend naturally to fall together and cohere, will, when this has taken place, be of necessity converted into a tube."

Clearly it should be an easy matter to excise a short length of the urethra by cutting out a portion of the 'riband' and bringing the cut ends together by catgut sutures. The knots of the sutures will all be inside the urethra, and will not be seen again; while the circular urethral wound, protected by means of perineal drainage from irritation by the urine and from contact with the catheter, is found to heal very readily.

The method of operating I am about to describe will be found to differ from that described in my original paper in the following important particulars: (1) The membranous urethra is not sought for and opened in the first stage, and often not opened at all. (2) The channel through the strictured portion of the urethra is disregarded and not looked for. In this way the most tedious and difficult steps of the operation are escaped; and the deep dissection and disturbance of the deep perineum in the search for the membranous urethra avoided altogether.

THE OPERATION.

The patient is placed in the extreme lithotomy position.

STEP 1. (*Fig. 154*).—The angular incision B A C, the apex A being over the central point of the perineum. The deep fascia of the ischiorectal fossa is seen, and must be opened on either side with a blunt instrument; the left thumb and forefinger are introduced so as to grasp the front portion of the external sphincter. This muscle is now severed from its attachment to the bulbocavernosus muscle at the central point and pushed backwards.

(The new method now diverges from the old, in which the next step was the membranous urethra.)

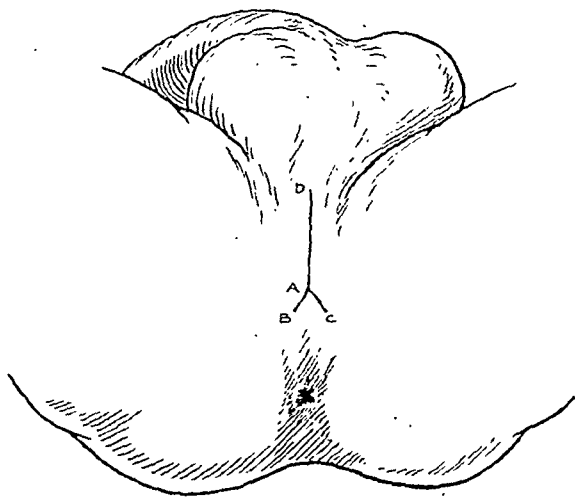


FIG. 154.—The angular incision, B A C, and mesial perineal incision A D. A should be over the central point of the perineum.

STEP 2.—The mesial perineal incision A D (*Fig. 154*), exposing the bulb and several inches of the corpus spongiosum and urethra, but without opening the urethra yet. Define the inflammatory mass comprising the stricture by dissecting it up on either side so as to loosen it in its bed, thus making it easy to lift it *en masse* out of its bed when the moment arrives.

STEP 3 (*Fig. 155*).—Take a full-sized metal bougie, straight for choice, and pass it down to the face of the stricture; clearly the whole of the urethra now occupied by the bougie is in good order and must be preserved. Make a transverse cut into the urethra over the point of the bougie, withdraw the bougie, and continue the transverse cut until the urethra is entirely severed (N.B.: in all its coats) immediately in front of the stricture. The sound urethra will now be entirely detached from the inflammatory mass (*Fig. 156*). During this step some slitting up of the sound urethra may be done if the surgeon thinks it helpful.

STEP 4.—Dissect the inflammatory mass out of its bed on the triangular ligament, working from before backwards and laterally. As it becomes loosened, turn it over backwards so that the dorsal aspect of it, with the urethra, the urethral foramen in the triangular ligament, and the face of the triangular ligament itself, all come into view (*Fig. 157*). The most distal portion of the mass—and that is where the stricture must be—is now nearest to the surgeon; on the upper aspect of the mass will be seen the urethra emerging from its foramen in the triangular ligament, to lie more or less embedded on the surface of the mass for a little distance, before plunging into it at the stricture site.

STEP 5.—To remove the stricture and the inflammatory mass with the minimum length of the urethra. We know that the stricture must be situated at the distal end of the mass, and that it must lie between the distal end (previously called the 'face of the stricture' when *in situ*) and that point at which we can see the urethra entering the mass on its dorsal surface.

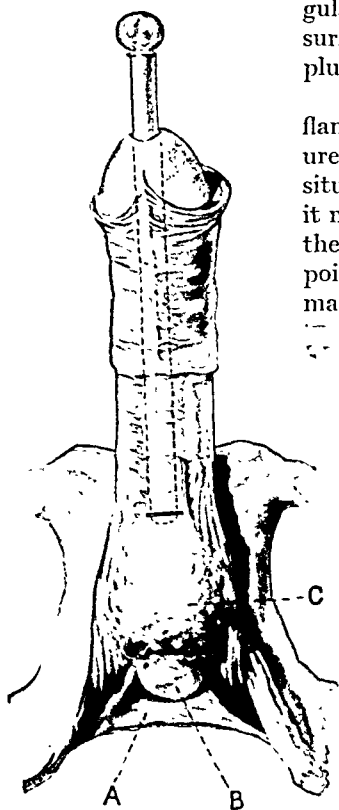


FIG. 155.—A bougie passed down to the face of the stricture, and the first transverse cut made over the point of the instrument. A, Triangular ligament; B, Bulb; C, Stricture mass.

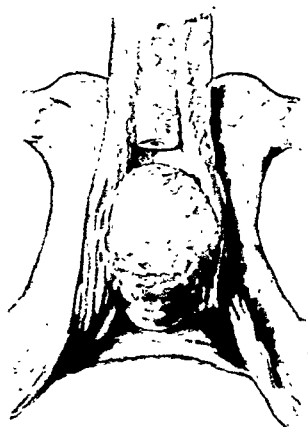


FIG. 156.—The corpus spongiosum and urethra completely divided.

Proceed thus: By a series of sections about $\frac{1}{2}$ in. thick, cut away the distal end of the mass until the open mouth of the urethra (*Fig. 158*) appears, with perhaps a little urine flowing from it; pass a full-sized rubber catheter through it into the bladder, thus proving that the stricture has been entirely removed. We can now clip away the remainder of the inflammatory mass with knife and scissors, and we are left with perfectly sound proximal and distal urethra to bring together across an intervening gap that looks wide, but will prove in reality to be trivial in extent.

STEP 6 (*Figs. 159, 160, 161*).—Preparation for suturing: Both the proximal and (if not already done) the distal portion of the urethra are now freely

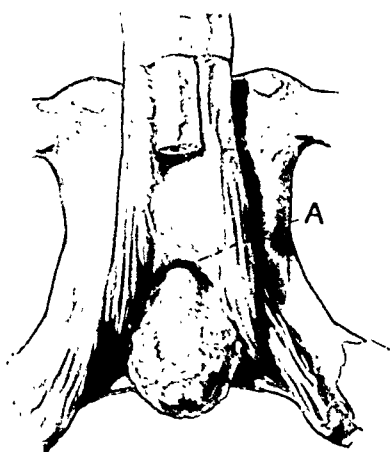


FIG. 157.—The stricture mass raised from its bed and turned backwards, exposing the urethral foramen (A) in the triangular ligament, with the urethra outlined on the dorsal aspect of the mass.

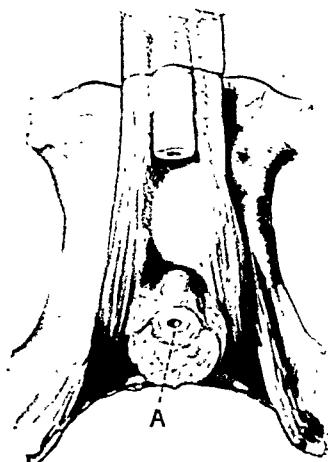


FIG. 158.—The face of the mass, together with the stricture, has been cut away in successive sections until the open mouth of the urethra (A) is exposed.

slit up, so that the interior of the canal is displayed, being now converted into a 'ribband' instead of a tube. The ends of the 'ribband' are then sutured

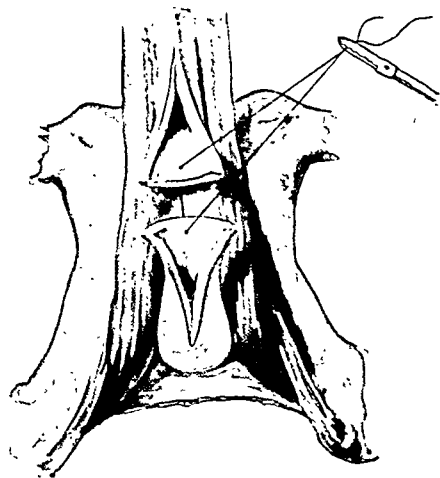


FIG. 159.—The proximal urethra has been cleared of the remains of the inflammatory mass, both proximal and distal portions of the urethra slit up to any extent that may be convenient, and the first suture introduced.

together with fine chromicized catgut, the knots being on the mucous surface and eventually inside the urethra. In passing the sutures, care must, of course, be taken to include a substantial share of the external coats of the urethra and corpus spongiosum. A good plan I see followed by some of my friends is to put one or two relaxation sutures into the outer coats. A rubber catheter is passed into the bladder and fastened with a suture to the skin; one catgut stitch passes through the skin on either side at the level of the central point of the perineum, and takes up also the anterior end of the triangular flap, thus bringing it into its proper position. (I think this suture may usually be omitted.) A suitable dressing is now applied, and the legs are released and brought down.

After-treatment.—On returning to bed, a rubber tube is attached to the catheter, and the urine conducted to a bottle suspended from the side of

the bedstead. Each morning, when the dressing is changed, the bladder and catheter are gently washed through with boracic solution. On the fifth day the catheter is removed, and complete healing of the perineal wound will rapidly take place. Frequently the urine will pass almost entirely through the penis during the first twenty-four hours after removal of the catheter.

The Passing of a Sound: When should this be done?—It would

appear, at the first glance, that the removal of a stricture and the substitution of an annular cicatrix, however accurately brought together by sutures, is likely to prove of doubtful value. The view has, in fact, been urged that in so doing we shall be merely replacing one form of stricture by another as bad. Nothing could be more erroneous than such a contention, and one of the most interesting observations we have made relates to this matter. Early in our experience we used to pass a full-sized instrument at the end of three or

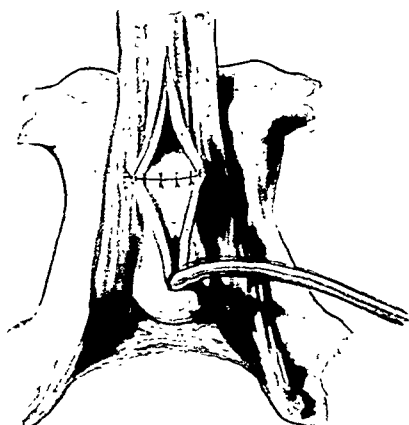


FIG. 160.—The suturing completed and the catheter introduced.

four weeks, and to me it was always rather an anxious proceeding; but I do not remember any occasion on which the instrument was arrested at the seat of the former stricture. On the other hand, experience, more or less acci-

dentally acquired, has shown that patients will go for three or four years after this operation without the passage of any instrument, and without experiencing any inconvenience whatever. At the same time I do not think it wise to let a patient alone for so long as this, for the following reason. There is no doubt that the circular cicatrix of the suture line does contract very slowly—so slowly that it takes four or five years to produce any recognizable effect on

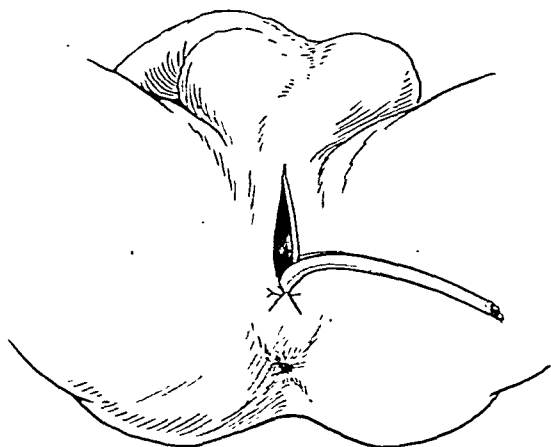


FIG. 161.—The operation finished.

the size of the stream. Then, however, the patient will probably notice that the stream is diminishing in size, and on instrumental examination it will be found that the opening will only admit a No. 5 or 6 English (I always

use the Lister graduated bougies). Nothing can be easier than to dilate the stricture up, and he will go on comfortably for another term of years.

In view of these facts, what exactly shall we do? It is difficult to be precise and categorical, but valuable light is thrown on this important question by a study of the following four cases:—

Case 1.—This case, although not one primarily of stricture but of complete severance of the urethra, is very instructive.

In October, 1910, R. L. B., age 26, sustained severe injury to the perineum by falling across an iron bar. For four weeks after the injury he passed water with great pain, difficulty, and bleeding; there was, however, no extravasation. On admission to the Alfred Hospital, examination of the perineum revealed a hard defined swelling about an inch in length in the course of the urethra. At the operation it was found that the urethra had been completely divided, and the distal severed end doubled in upon itself into the urethral channel, causing the small but defined swelling that was felt externally, and leaving an inch or more of the urinary channel formed only by the external fibrous sheath of the corpus spongiosum, which sheath had escaped laceration. In order to restore the urethra, the doubled-in portion was freely slit up, and also the end of the proximal torn portion; the ends were then adjusted and sutured together with catgut. To my great surprise no stricture formed, and in July, 1913, no instrument having been passed for two years, a full-sized bougie passed without any hitch whatever.

I supposed that he was permanently free from further trouble as the result of his injury; but no. Although I frequently saw him during the next few years, he astonished me one day in 1918, five years after the last instrumentation, by coming to see me with reference to his urinary stream, which seemed to be contracting. On examination, the circular cicatrix admitted a No. 7. Full dilatation was at once carried out, and he has not needed any further treatment, although eight years had passed.

For the purpose of this paper I asked him to visit me on March 25, 1926. There had been no sign of diminution of the stream since the last dilatation eight years ago. I now passed one instrument, Lister 11-14, into the bladder; there was just sufficient resistance, as the bulbous end passed through the circular cicatrix, to locate its position; that was all.

*Case 2.*¹—R. T., age 38. Operation in Alfred Hospital, Nov. 12, 1917. This man had endured dreadful suffering for three or four years. The operation afforded complete relief, but no persuasion or explanation could induce him to come back to see us. Instead, he was surly and quite thankless. In a later publication² I was able to make this further note:—

"1923. This man has been seen by my former house surgeon, Dr. W. S. Newton. The man states that he is quite well, although no instrument has been passed since the operation" (six years).

I believe that although six years had passed since the operation in this case, this foolish man has only to go on long enough and he will be in serious trouble; but it will probably prove to be only after the lapse of perhaps ten years from the operation.

*Case 3.*³—W. K., age 55. Operation for stricture in Alfred Hospital, Feb. 12, 1916. No instrument was passed after the operation. He explains that he returned to the hospital on one occasion but failed to see me, and did not go again. He was seen on March 5, 1919, three years after operation. He stated that he had experienced no trouble whatever, but had been mentally apprehensive lest he should suffer through neglecting to have an instrument passed. On examination, Lister bougies 9-12 and 8-11 were arrested at the site of the old stricture; 7-10 passed through, and dilatation was at once proceeded with up to 12-15. I have not seen him since.

Thus it will be seen that in the case of this man the process of contraction of the circular suture line took three years to reach the size of No. 7, but he had not yet noticed any diminution of the stream.

Case 4.—Medical practitioner, age 54. Operation December, 1921. First instrument passed March, 1926, four and a quarter years after operation. He had noticed some diminution in the size of the stream latterly. Lister 5-8 passed, and dilatation up to 9-12 was at once carried out.

An interesting and useful piece of information seems to emerge from a study of three of these cases in regard to the rate of contraction of the circular suture line. Roughly, it would appear that the rate of contraction will be about two catheter sizes (English) per annum. Estimating the normal calibre of the urethra at Nos. 12 to 14, at the end of the first year contraction will have taken place down to No. 11, at the end of the second year to No. 9, at the end of the third to No. 7, at end of fourth to No. 5; and now for the first time the patient will perhaps notice that the stream is becoming smaller. This is on the assumption that no instrument has been passed during these four years. On the other hand, if the urethra is fully dilated once a year during the first years after operation, the rate of contraction greatly diminishes with age, so that the interval between instrumentations may be extended to several years (cf. *Case 1*, in which after the third year no instrumentation was required until five years later, when No. 7 passed; then after a further interval of eight years there was no diminution of the stream, and No. 11 passed).

Putting the result of these observations into tabular form :—

1. Where no instrument is passed for several years following operation (*Cases 3 and 4*) :—

At end of 1st year contraction to 11 (English)									
"	"	2nd	"	"	"	9	"	} Diminution of stream noticed.	
"	"	3rd	"	"	"	7	"		
"	"	4th	"	"	"	5	"		

2. Where the stricture is looked after—dilated once per annum during first three years after operation (*Case 1*) :—

During 5 years from 3rd to 8th year, contraction took place to No. 7.
During 8 years from 8th to 16th year, contraction negligible.

Needless to say, there is nothing 'absolute' about these tables. They simply represent exactly what happened in three cases. Further observation is sure to teach us more. Meanwhile I think that, if the above facts be carefully studied, they will be found to furnish a solid basis for very valuable working principles, and I would suggest the following programme as seemingly a sensible one :—

Examine the urethra every twelve months for the first three years, always dilating fully, and be guided by the behaviour of the case as to the future conduct of it. The patient must, of course, have the position explained to him, and be told to come without delay should any diminution of the stream become noticeable; but that is not likely to take place until after the lapse of several years.

The Advantages of Perineal over Per-urethral Drainage.—For one thing, there is always a tendency for a little urine to run down outside the catheter; the perineal catheter conducts such urine outwards through the perineum and away from the suture line in the urethra. On the other hand, penile drainage permits immediate closure of the perineal wound, so that any urine passing into the urethra remains there, with resulting gross contamination of the suture line. This, together with the mechanical disturbance resulting from contact of the catheter with the suture line, is unfavourable to quiet healing. The perineal route of drainage is, in my opinion, indispensable.

Note on Perineal Access to Urethra.—Although this matter is not essentially involved in the operation I have described, it is nevertheless of interest and importance, and should be included in this paper. The urethra from the apex of the prostate to the base of the glans penis may be exposed and laid open through a perineal incision carried forward so as to invade the posterior half of the scrotum. It is done in the following way:—

1. Exposure of the membranous urethra, and the detachment anteriorly of the external sphincter from the bulbocavernosus muscle (*vide supra*).

2. A mesial perineal incision extending forwards to near the base of the scrotum. By retracting the skin forward, the bulb and perineal urethra may be slit up to the extent of 3 or 4 in.

3. If we desire to expose still more of the urethra, it may be done by prolonging the incision forward so as to invade the scrotum to the extent of about 1 in. By again retracting the scrotum forwards we shall be able to expose and slit up the urethra as far as the root of the penis.

4. If the penile urethra is fibrosed and strictured, and we wish to examine the interior of it, this can still be done through the perineal wound by further prolonging the incision until the scrotum is bisected in its posterior half. The finger can then be run along by the side of the urethra, hooked over the dorsum of the penis at its root, and the penis stripped out of its skin and brought naked into the field of operation, the penile skin being now turned inside out like an umbrella. If desired, the penile urethra can now be slit up as far as the base of the glans without wounding the penile skin. There will be no need for suturing any portion of the urethra; the scrotum alone will need a few stitches.

It seems almost unnecessary to add that such an extensive slitting up of the urethra as this would be neither wise nor profitable unless in the presence of very general and severe fibrosis of the urethral walls and corpus spongiosum. Strictures of the penile urethra are quite unsuitable for excision in any case. I have inserted the description of this mode of access because there are cases in which it is valuable, and such cases are not very infrequent.

Note on Urethral Stricture and Syphilis.—It should be borne in mind that practically every case of inflammatory stricture has been dangerously exposed to syphilitic infection, and a blood test should always precede the operation of excision. In one of my early patients a diffuse brawny swelling of the tissues of the perineum followed the operation; secondary

hæmorrhage occurred, and the result of the operation was unsatisfactory and the stricture recurred. I have heard of at least one other case which was attended by the same results; in both cases the blood test for syphilis gave a positive result. While I am not convinced that the phenomena were traceable to syphilis alone, the lesson is nevertheless one that should not be disregarded.

Finally, I desire to acknowledge my special indebtedness to my friends, Victor Hurley and Alan Newton, of the Melbourne Hospital. They have both carried out the operation described in this paper with complete success and satisfaction, while according to me the rôle of privileged collaborator and assistant. I myself have never done the operation as here described, owing to my being no longer in active surgical practice. The semidiagrammatic illustrations have been drawn from my description, with free use of a figure in Spalteholz' *Hand Atlas of Human Anatomy*.

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SYPHILITIC ARTHRITIS.

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*(An article based upon a Hunterian Lecture delivered before the Royal College of Surgeons of England on Feb. 6, 1925.)***INTRODUCTION.**

SYPHILITIC arthritis seems to have been recognized as a clinical entity by the ancients, and it was well known and described in the Middle Ages (e.g., Petrus Maetyr in 1485, and Feyrus in 1537); it is mentioned also by a number of the writers at the Renaissance period, and notably by Fallopius, writing in 1574. At a later date this knowledge seems to have been entirely forgotten; John Hunter, writing in 1786, knew nothing about the condition, though he knew that 'mercury cured rheumatism', a fact which is also mentioned by Villelobos in 1498. It was not till 1817 that Sir James Russel recognized syphilis as a cause of arthritis, while Richet wrote the first clear description of the condition, and distinguished it from scrofula, in 1853. Then, in 1886, followed Clutton's classical paper.

Since then, many articles have been written upon the subject, and it is easy to compile a bibliography of three or four hundred references; but though the subject is well known by individual writers, it is not one that is at all widely recognized by the generality of our profession, and the diagnosis is seldom made. Text-books dismiss the subject, as a rule, with a few lines, and certainly the majority of doctors regard syphilitic arthritis as being a rare disease and one that hardly enters into practical diagnosis or treatment.

The particular object of this paper is to show that the disease is by no means so rare as it is commonly thought to be; to direct attention to the fact that it assumes many forms, several of which closely resemble other conditions; to emphasize that syphilis is a cause which should be borne constantly in mind when the diagnosis of a case of arthritis is under consideration, and that in every case the presence or absence of a luetic factor should be investigated and considered; and lastly, it is proposed to describe one or two of the rarer manifestations of syphilitic arthritis, such as are probably not generally recognized as being syphilitic.

Charcot's parasyphilitic arthropathy is well known, and will be dismissed without further mention, while little need be said about Parrot's syphilitic osteochondritis or syphilitic osteitis, both of which are well-known conditions.

Definition.—It is necessary, of course, to draw a very definite distinction between syphilitic arthritis and arthritis occurring in a syphilitic subject. By syphilitic arthritis is meant arthritis due to syphilis. In a good many of

the recorded cases, it is evident that the diseases described were not really due to syphilis, but were simply cases of rheumatic arthritis, gonorrhœal arthritis, or some other condition, occurring in a syphilitic subject. This, no doubt, explains the very variable character of the clinical pictures described and the response to treatment. A true syphilitic arthritis is one which is fundamentally due to syphilis, and is curable by antisyphilitic treatment, at any rate if it be diagnosed fairly early. The last is a very important criterion in diagnosis, and is a much more important piece of evidence than any Wassermann test.

Frequency.—Statistics as to the frequency of syphilitic arthritis are absolutely unreliable, for two reasons: (1) Many cases are unrecognized and wrongly diagnosed; (2) Many recorded cases are those of arthritis occurring in syphilis, and not of syphilitic arthritis. Certain facts, however, are suggestive: (1) Parrot says that 5 per cent of all congenitally syphilitic babies have arthritis; Fournier gives the figure as 39 per cent, whilst von Hippel says that 56 per cent of a consecutive series of 77 children with keratitis punctata and other well-recognized stigmata of syphilis had arthritis; in the vast majority of these cases the knees were affected. (2) Schüller states that 70 per cent of all arthritis in children is syphilitic. (3) Paëts says that 63 per cent of natives working upon the Panama Canal suffering from acute arthritis had syphilis, and that the arthritis itself was syphilitic. (4) Lacatère states that 70 per cent of the natives of Morocco have syphilitic arthritis, a fact which is due to the extreme prevalence of syphilis amongst the natives, and their habitual neglect of all forms of treatment.

If it be true that arthritis is as common as has been stated in congenital syphilis, there must be a large number of these cases, persisting into later life, undiagnosed and quite unaccounted for, even after due allowance has been made for the death of a number of these children, and the disappearance of the disease, even without treatment, in a number of other cases. Moreover, this consideration applies only to those cases which are due to congenital syphilis; it takes no account of the comparatively large number of cases due to the acquired disease.

Von Hippel makes this very important observation: *no case of syphilis that has been efficiently treated ever develops syphilitic arthritis*. It seems probable, therefore, that with the highly efficient organization that has now been created for dealing with this disease, in the way of clinics for the treatment of venereal diseases, and the like, this disease will gradually be altogether eradicated: meanwhile, it is essential that every member of our profession (not the specialists only, but the rank and file also) should learn to diagnose the disease in every possible case, in order that dissemination by untreated patients may cease as soon as possible.

The disease occurs in all stages of syphilis, both congenital and acquired. It is a *protean condition*: there can be no such thing as a typical word-picture of syphilitic arthritis. It occurs in many forms, and in very variable degrees of severity, whilst the various forms are not clearly demarcated from one another: transitional forms are found between the various clinical types, so that the whole form a more or less well-graduated series from the mildest cases up to the most severe.

ARTHRITIS IN CONGENITAL SYPHILIS.

In congenital syphilis, arthritis occurs in two forms which are more or less peculiar to this stage of syphilis, and in one form which is common both to the congenital and to the acquired disease. In infants, the typical form is *Parrot's syphilitic osteochondritis*, whilst in older children the well-known '*Clutton joint*' is the common form. In addition to these forms, we meet with certain others which are exactly analogous to the tertiary syphilitic forms met with in adults.

Parrot's Syphilitic Osteochondritis is a juxta-epiphysal inflammation. It occurs in about 5 per cent of congenitally syphilitic children, usually in the first three weeks of life, and practically always during the first three months. It affects the upper more frequently than the lower limbs, which is in contrast with the plastic and other later forms of syphilitic disease. The lesion is a gelatiniform change in the cartilage and bone. These break down to form a greenish-yellow fluid, from which a strongly positive Wassermann reaction is obtainable. The fluid is scanty in quantity. Suppuration may or may not occur, and may or may not be microbic. In many cases complete separation of the epiphysis occurs, and in many instances it is fractured, a fact which is perhaps not as well known as it should be.

The X-ray changes include:—irregularity of the epiphysal line; a widening of the articular space; thickening of the periosteum; decalcification of the region of bone immediately proximal to the cartilage; a 'cupping' of the diaphysis, and a certain irregular density and streakiness of the bone in the region immediately adjacent to the cartilage. The prognosis depends very much more upon the presence or absence of visceral changes than upon the condition present in the bones themselves. Given *timely treatment*, it is possible to produce a complete resolution in the injured joint; but if the growing-line be much damaged, permanent shortening or deformity may occur; and if the disease occurs in a situation where there is a pair of epiphyses, and one of these be affected more than the other, e.g., at the ankle or at the wrist, considerable deformity may occur later. This condition is somewhat comparable with the marked in-bowing or out-bowing of the elbows which may occur at about 50 years of age or so, a condition sometimes described as *Stoll's elbows*.

Clutton's Joints.—The joints commonly known by this name were first described by Clutton in 1886. The condition consists in a symmetrical hydrarthrosis affecting both knee-joints in children of 8 to 16 years. The onset is insidious, and there is no pyrexia. A certain characteristic is the absence of pain, which contrasts curiously with the marked swelling of the two knee-joints. In spite of the effusion, the patients are able to walk quite well.

In the vast majority the knees are affected—(41 out of 45 cases). In a good many cases there are eye changes also, the joint disease preceding the eye changes in over 80 per cent. X-ray examination reveals no abnormality beyond the mere distention of the synovial sac, and a certain amount of separation of the bones in consequence. The clinical picture of a case of Clutton's joint is very characteristic, and is, as far as I know, quite

pathognomonic. With regard to this disease, it is possible to formulate a clinical aphorism.

CLINICAL APHORISM No. 1.—*Bilateral, painless hydrops of the knees in children is due to syphilis.*

The prognosis is favourable; the condition responds very well to treatment, though it is somewhat prone to relapse. With prolonged treatment, however, complete cure usually results, and it is seldom that the disease persists and becomes chronic; at the same time it must be remembered that in occasional instances this takes place, and it is not possible to tell beforehand which are the cases in which this may occur. Whilst the outlook, therefore, is usually favourable, it is obvious that it is unwise to give too confident a prognosis, especially as a few cases are on record which, beginning as typical Clutton's joint, have ended up with bony ankylosis in spite of the most vigorous and prolonged treatment.

Lastly, there are various types of arthritis which one encounters in congenitally syphilitic children which are exactly analogous to the tertiary syphilis seen in adults. I will postpone consideration of these until I have described the earlier forms which occur in adults; the tertiary forms can then be considered all together.

EARLIER FORMS OF SYPHILITIC ARTHRITIS IN ADULTS.

In *acquired syphilis* arthritis is encountered in various forms and at every stage of the disease. There is no strict delimitation of certain forms to certain stages. Moreover, one form may merge into another, whilst in other cases the forms retain their individuality throughout. One form may appear in more than one clinical stage of syphilis; for example, hydrarthrosis appears in the secondary, the intermediate, and the tertiary stages of the disease. On the whole, however, one may say that syphilitic arthritis is more severe in the later stages of syphilis. It affects the joint structures more deeply, and is very much more destructive, and also more resistant to treatment. Unless it is diagnosed early, and treated vigorously, it is one of the most disabling of joint affections—considerably worse than tuberculosis, for it remains in a half-cured state for many years, and is very resistant to treatment. A tuberculous joint, treated according to the most approved modern methods, usually undergoes complete resolution, or else bony ankylosis; it is only in inadequately treated cases that partial limitation of movement, or partial ankylosis, occurs. A joint which is freely movable is trustworthy, and a joint which is firmly ankylosed is trustworthy. A joint whose range of movement is markedly restricted, or whose range of movement, even within certain limits, is not smooth and painless, is a constant source of disability, unreliability, and perhaps even danger. This is the very condition in which undiagnosed syphilis, or inadequately treated syphilis, is liable to leave a joint.

For example, I have in mind a boy of 12 years, who was diagnosed at first as a case of tuberculous arthritis of the knee-joint, and was treated upon that assumption, though in a rather indifferent manner. The result is that now, seven years after treatment began, he is left with a knee which is neither cured nor yet very active: which refuses to respond to antisypilitic, or any

other, treatment ; which is not ankylosed, and yet which is very far from being freely or painlessly movable ; which, in short, is a constant source of annoyance and difficulty to him. It being a case of syphilis, one hesitates to excise such a joint, quite apart from the undesirability of excision at this age for other reasons, such as recurring flexion ; the only prospect, therefore, seems to be that this boy will have to wear a caliper until he is grown up, and perhaps even afterwards.

D'Arey Power's classification of syphilitic arthritis is as follows:—

Secondary syphilis	{ Arthralgia Synovitis { Intermittent { Chronic
Tertiary syphilis	{ Gummatus synovitis Chondro-arthritis, ulcerating or Virchow's joints Tabetic, sclerosing, or Charcot's joints
Congenital syphilis	{ Suppurative arthritis Hydrarthrosis Symmetrical serous synovitis or Clutton's joints Gummatous synovitis Chondro-arthritis, ulcerating, or van Gies' joints

It is not, in my opinion, a complete classification, according to our modern knowledge of the disease, but it is the best that exists, and I quote it in its original form. It must be understood, of course, that it is not to be taken in too arbitrary a sense, and that a certain amount of 'overlap' occurs; that is to say, whilst certain fairly well-defined forms of syphilitic arthritis occur at various clinical stages of syphilis, there are transitional forms also, and the occurrence of the types is not confined to the stages mentioned.

Arthralgia is often regarded as rheumatic. It may appear even before the early rashes; the pain is never severe in character, and would often be more correctly described as an 'ache' than as an actual pain; as in tertiary syphilis, it is very often chiefly nocturnal. It is rather characteristic that gentle passive movement does not increase the discomfort at all; in muscular rheumatism, fibrositis, and similar conditions, movement increases pain, as is well known. The marked increase of discomfort at night, and the absence of increase of discomfort upon movement, will sometimes serve to suggest the correct diagnosis; in some cases, the administration of antisypilitic remedies causes a temporary increase in the amount of pain, and this usually clinches the diagnosis. A Wassermann reaction confirms this, and the continued administration of suitable remedies produces a rapid and permanent cure. The arsenical derivatives are more effective, as a rule, than the older mercurials. The pathology of the condition is not accurately known, as no one appears ever to have cut into a joint at this stage; but as the range of movements is never restricted, it seems probable that the condition is not one of effusion into the joint-cavity; if a joint becomes acutely distended, there is usually some flexion, and some limitation of movement. It seems more probable, therefore, that syphilitic arthralgia consists in an infiltration of the muscles, fasciæ, etc.

CLINICAL APHORISM No. 2.—*Never diagnose rheumatism in any form until syphilis has been excluded as a possibility in the diagnosis.*

Hydrarthrosis occurs in secondary syphilis in two forms, viz.: (1) *Transient hydrops* (early); and (2) *A later, more persistent form*.

1. The transient early hydrops usually affects the knees, but may be polyarticular. Fluid is abundant, and the synovial membrane is swollen. There are no signs of redness as a rule. Pain is moderate, and gentle passive movement does not hurt, though interosseous pressure may do so. It responds very readily to antisyphilitic treatment, and especially the employment of arsenical drugs. The condition pursues quite a mild clinical course as a rule; but in exceptional instances it is exceedingly acute, and even simulates the presence of suppuration. It is, however, characteristic of the disease, even in this very severe form, that the timely administration of antisyphilitic remedies produces a rapid and complete cure. Pain, tenderness, malaise, and pyrexia—all or any of these may be present or absent.

2. The later and more persistent form of hydrarthrosis may be chronic from the outset, or may become chronic, following an acute onset. This condition may be symmetrical, and then, like Clutton's joint, the condition is extremely suggestive, and practically pathognomonic, of syphilis. It is seldom that the two joints are equally affected at any given moment; as a rule one side starts first, and the other follows later, and under treatment one side gets well sooner than the other. There is a marked tendency to relapse—usually at irregular intervals, though occasionally the relapses are periodic. The disability, as compared with the amount of distention of the joint, is very slight, and so is the muscular wasting. Discomfort is moderate in amount, and sometimes the joints are quite painless. The condition may disappear spontaneously, very much as a Hunterian chancre may, even in the complete absence of treatment. The diagnosis is made upon these characteristics, together with the Wassermann reaction, the presence of other evidences of syphilis, and (most important of all) the effect of antisyphilitic remedies. The presence or absence of a history of syphilis is of very little account; one French writer mentions that of eighteen cases in which the diagnosis of syphilis was well established, not only upon clinical signs, but also by the Wassermann reaction and the effect of subsequent treatment, only one patient admitted infection, even when taxed directly with it. Sometimes, however, the family history may give a certain amount of help.

The Plastic Form of secondary syphilitic arthritis is much rarer than hydrarthrosis. There is, as a rule, a long history; there is thickening of the synovial membrane, and especially of the perisynovial tissues; the whole joint seems swollen, and the swelling has the shape of the joint-cavity; but there is, in fact, very little fluid present, and the greater part of the swelling is due to a general tumefaction of the soft parts about the joint; such fluid as there is, is turbid and thick, but not flaky or stringy. It gives a positive Wassermann reaction in 100 per cent of cases, and the Wassermann reaction in the blood-serum is positive in a majority of cases. It is very difficult to detect any spirochaetes in the joint-fluid, but lymphocytes are present in great abundance, whilst polymorphs are in a minority. There is usually a fine crepitation on movement, and a certain amount of pain, though not very much. Pyrexia is absent. The response to treatment is very slow, but most cases seem to recover eventually; they often take one to two years in doing

so. The later the diagnosis is made and treatment is begun, the more chronic will the disease be. The crepitation is no doubt due to the rubbing together of thickened soft parts, for it may disappear altogether after treatment, and does not necessarily indicate that ankylosis is inevitable. The plastic form of syphilitic arthritis is usually monarticular, but may be polyarticular in a patient whose syphilis has been neglected. As a rule a big joint is affected, and usually the knee. The order of incidence of the condition in the various joints appears to be: knees, elbows, mid-tarsal, shoulders, wrists.

No sharp border-line can be drawn between these cases and those in which there is some affection of the bone itself; transitional forms occur, and, if the bone is affected, the disease may terminate in some cases by changes of an osteo-arthritic character.

TERTIARY SYPHILITIC ARTHRITIS.

GUMMATOUS ARTHRITIS.

In the early stages of this condition it is the synovial membrane that is mainly affected, and the joint is distended. At this stage the use of mercury and other remedies will effect a speedy and apparently permanent cure. As a rule, however, actual structural changes, such as fibrosis, etc., are present, and these cases are therefore much less favourable than the preceding forms. Even at this stage, timely treatment is still capable of effecting a cure, but later forms are amongst the most chronic known. Occasionally acute and sudden in onset, they are usually the reverse. The pathological changes may be fibrotic or ulcerative from the very first (i.e., cases of tertiary syphilitic type), or may develop out of secondary syphilitic forms, such as hydrarthrosis or possibly the plastic form. When occurring in children, these joints are sometimes described as van Gies' joints. They simulate tuberculosis very closely, and probably most cases are mistaken for that condition. Reschke mentions a case in which one knee was excised for tuberculosis; an ulcer next appeared in the mouth, and this also was regarded and treated as being tuberculous; eventually, the suggestion of syphilis was made, and a Wassermann reaction proved to be strongly positive; antisypilitic treatment effected a complete cure, both of the joint and of the mouth, within a few weeks.

The gummatous process may be purely local, or it may affect the whole joint, and any structure of the joint may be affected. The condition may result from congenital or from acquired syphilis, and the pathological picture and process are identical in either case. Axhausen has described two forms, namely, (1) *Synovial*; and (2) *Osseous*.

1. **The Synovial Form.**—Occurring chiefly in children, this disease is usually the result of congenital syphilis. Sometimes there is a history of trauma, which may lead to an erroneous diagnosis of tuberculosis. As a rule the larger joints are affected, the order of incidence being: knee, ankle, elbow, shoulder; but the smaller ones may be affected, e.g., the interphalangeal joints. As a rule the effusion is very considerable in amount, because the patient is able to get about better than he could if the disease were tuberculous, the condition being a painless one. Exceptionally, however,

the pain is great, and in these cases the disease is commonly diagnosed as being tuberculosis. Though called 'synovial', the condition is, strictly speaking, a perisynovitis. The lining endothelium and articular cartilage remain shiny, and it is the outer layers, i.e., the perisynovial tissues, which become thickened. They form what has been described as a pseudo-tumor-albus. In exceptional cases a fungous form of arthritis is present, with local projections of coral-like form into the joint.

It is obvious that the simulation of tuberculosis can be very close, but certain points assist in the differential diagnosis: there is less muscular wasting than in tuberculosis, and, even after years of neglect of treatment, there may be little pain and little restriction of movement, whilst suppuration is practically unknown, and no other complications occur. It is practically inconceivable that a child with a greatly thickened tuberculous joint could go about for any length of time without splintage or other adequate treatment, and yet not suffer grave aggravation of his complaint; and in any case, supposedly tuberculous, in which this condition of affairs is present, the diagnosis of syphilis should be seriously entertained and duly investigated. The presence of an irregular, local, lumpy thickening about the joint should always suggest the possibility of syphilis, though in rare instances tuberculosis gives rise to a similar condition. The diagnosis will rest mainly upon the result of a Wassermann test and the effect of treatment, whilst in some cases a helpful indication will be derived from the presence or later development of other evidences of syphilis, such as periostitis, eye changes, etc. As in all cases of suspected joint syphilis, the joint should be punctured, and the Wassermann reaction tested upon the joint-fluid as well as upon the patient's blood-serum.

CLINICAL APHORISM No. 3.—*Never diagnose tuberculosis or any other form of arthritis until you have excluded syphilis.*

2. The Osseous Form.—When this occurs in young patients, it may be primarily an epiphysitis; the articular surface becomes eroded and irregular, and there may be cavitation in the interior of the bone, together with bony outgrowths and a secondary eruption of the inflammatory process into the joint. In adults, the condition bears a considerable resemblance to an ordinary osteo-arthritis in many cases, and in most cases osteo-arthritic changes eventually appear. X-ray examination reveals the characteristic bony changes, together with distention and some increase in opacity of the soft parts about the joint. Though described for convenience as the osseous form, it must not be assumed from this description that the disease is by any means confined to the osseous system: on the contrary, all the structures which enter into the formation of the joint are usually affected, and the condition is merely described as osseous because it is in the bones that the most marked changes occur. In some instances, the joint changes are merely a part of a widespread disease of the skeleton, and the bones are profoundly affected by tertiary syphilis, and extraordinarily deformed, throughout the whole of their length, or at any rate in parts altogether external to the articulations. It is not uncommon for gummata to break down and discharge externally, in which case obstinate sinuses result.

Sometimes the spine is affected, and there is then a very close simulation of tuberculosis, and as a rule it is only when some more obviously syphilitic lesion makes its appearance (e.g., interstitial keratitis) that the diagnosis of syphilis is even entertained. In the few cases which I have seen the disease has been treated for several years as tuberculous, though perhaps the possibility of its not being tuberculous should have been entertained when it was noted how very little the condition was responding to treatment. Sometimes the simulation of tuberculosis is rendered even closer by the presence of skin lesions which mimic tuberculosis very closely.

Case 1.—M. E. K., age 6, was an in-patient of Guy's Hospital, and underwent twenty-two operations for 'tuberculosis' of the glands of the neck, and was also under treatment for tuberculosis of one hip-joint and the opposite knee-joint. She was seen, in the course of her hospital career, by several surgeons, and no doubt seems ever to have been entertained as to the correctness of the diagnosis. A new house surgeon, anxious to distinguish himself, and with mind unbiased by previous diagnoses, suggested that a Wassermann test should be carried out; this was done, and a strongly positive result was reported. Salvarsan was administered (this was in the early days, when the drug was given intramuscularly), and within ten days the child became completely well.

I had the opportunity of watching her for two years afterwards as an out-patient, and during this time there was no evidence of any relapse. There can be no doubt, therefore, that the disease was syphilitic.

Case 2.—Jimmy W., age 18, had been treated at several of the large hospitals in London for old 'tuberculous' caries of the spine, with the usual hump-back deformity, for which he was wearing a spinal support. The case appeared to be, in all respects, a typical spinal caries, and it was only when evidences of tabes appeared, and he was referred to the Neurological Department, that the diagnosis of syphilis was suggested. Ocular symptoms supervened, and though treatment with '606' was given, only partial relief ensued; but the interesting feature was that the eyes underwent material improvement, and ceased thenceforward to cause any pain at all.

It is not possible to say that this may not have been a case of tuberculosis of the spine associated with syphilitic disease, but it seems more probable, in view of the later history of the case, that the spinal condition also was syphilitic.

In adults, the whole of one large joint is affected—as a rule, the knee. Sometimes there is associated osteitis—this is the commonest form; sometimes the condition is a pure synovitis or arthritis. When bone changes are present, these may be extensive, and affect the whole length of the bone, or at any rate a considerable length exterior to the joint, or the changes may be confined to the intra-articular part of the bone. As a rule the changes are of an osteo-arthritic nature, and consist in the formation of marked osteophytes and other excrescences; occasionally, masses of bone form in the reflexions of synovial membrane, or other soft parts of the joint. In some instances the bone may be locally enlarged, or tender, or both. The disease may erupt into the joint, producing secondary arthritic changes there, or may form external sinuses. Now and again one meets with the development of small cavities in the interior of the ends of the bones, e.g., the external malleolus or the olecranon process. In such cases, there may be considerable pain, before the enclosed cavity bursts to the exterior.

Even in well-established gummatous arthritis, timely treatment is still capable of doing great good, though not so much as in the earlier forms

of the disease. However, it is particularly important to institute thorough and prolonged treatment, because the issue of the case, if this is not done, is so particularly serious. If the treatment be delayed, or inadequate, the usual result is the development either of (a) gross osteo-arthritic changes, of the proliferative osteophytic type, or else (b) ankylosis. The latter is especially likely to occur if the diagnosis is missed and no antisypilitic treatment is given. If the articular cartilages be destroyed, bony ankylosis may ensue, and very often gross deformity takes place in the meantime, so that the ultimate result is very severe crippling. Even so, however, this result is to be preferred to the development of a fibrous ankylosis, which is nevertheless a fairly common result of this condition. A fibrous ankylosis is the worst of all possible results of any kind of arthritis, for such a joint lacks the freedom of movement that is necessary to insure immunity from injury, and also the absolute stability which bony ankylosis confers. Moreover, in a case of syphilis, the development of fibrous ankylosis is particularly deplorable, because there is a greater risk in attempting to convert this into a firm bony ankylosis by the performance of arthrodesis than is present in a tuberculous case; there appears to be a definite risk of non-union in these cases, even after a thorough prophylactic course of treatment.

If there is any destruction of articular cartilage, no weight-bearing should be allowed, though movements of the joint need not be excluded. In the case of the lower limb, this means that a weight-bearing caliper should be applied throughout the active stage of the disease, and its use should be continued until the constitutional affection is showing a satisfactory response to treatment, and the joint condition shows a marked subsidence. On the other hand, it is important that the mobility of the joint should be retained, by frequent movements of the joint, when it is not subject to weight-bearing, or else there is an added risk of imperfect ankylosis. In the case of a hip or knee, therefore, the patient should be strictly enjoined to wear his caliper from the moment he rises till the moment he lies down, and to take it off daily, in order to exercise his joint, and put it through its full range of movements.

Guyot mentions a case in which the appearance of this disease directly ensued upon an injury, and in such a case the whole condition might well be regarded as post-traumatic tuberculosis, unless the possibility of syphilis were borne in mind and investigated.

CLINICAL APHORISM No. 4.—*Monarticular arthritis of a deforming type at any age, with or without pyrexia, may be syphilitic.*

A PSEUDO-RHEUMATIC FORM.

This occurs (1) *In Children*, both congenitally syphilitic and those who have acquired the disease; and also (2) *In Adults*.

1. In children it may ensue upon Clutton's joint, either early, or after the lapse of one or two years. Sometimes several joints are involved simultaneously, and, if so, one is worse than another, as a rule. The order of frequency is: knees, ankles, wrists, elbows. In some cases one finds that, as one joint is getting better, another becomes involved; this may lead to a suspicion of rheumatism, properly so-called, but (a) the condition does

not respond at all to treatment with salicylates, and (b) the rate of evolution of the case is usually much slower than in true acute or subacute rheumatism. A further point in the differential diagnosis is the fact that keratitis occurs in somewhere about 75 per cent of the cases. Probably, however, the most important point of all is the fact that little pain occurs; there may be slight discomfort when the joints are moved, or perhaps the complaint will only be of stiffness. There is distention of the affected joints, but they are not red, and there is little or no muscular wasting, whilst the temperature, often normal, seldom reaches 99°. It appears that the condition is one which is seldom recognized; but the clinical picture of a polyarthritides in a child, without heat, redness, wasting, pyrexia, night-starting, or response to salicylate treatment, and without pain, should make up a pretty characteristic picture. Von Hippel mentions a child who suffered from this disease for five years, and Gilbert quotes one in whom nine joints had been involved in the course of five attacks. If, in a case of polyarthritides in a child, there is no response to salicylates, it is impossible to maintain a diagnosis of rheumatism; on the other hand, if the case should prove to be syphilitic, the response to appropriate antisyphilitic treatment will be rapid and convincing. The following case is of interest in this connection:—

Case 3.—P. J., age 8, limped for about two months, and her mother noticed swelling of the left ankle; she said that the ankle had been hurting her for about two days. A diagnosis of subacute rheumatism was made, and she was given salicylates. She had also a pustular eruption all over her body, resembling *acne vulgaris*, on and off for about a year. Her family doctor, Dr. Moor, of Westgate-on-Sea, noting that she was an habitual mouth-breather and mentally slow, administered dry thyroid extract, and most of the pustules disappeared in a month or so.

In the following month her left knee developed a swelling, and this was painless; a diagnosis of tuberculosis was made, and the patient was put in a splint. The swelling slowly subsided.

Two months later several pustules just above the left ankle coalesced so as to form three large red patches, as large as a penny or larger, resembling lupus: the skin was thickened and of the characteristic 'apple-jelly' appearance at the edges. Though there was no actual ulceration, it was thought that this might possibly have been the result of the rubbing of the splint. The sore gradually subsided, and was replaced by depressed scars, which have since been slowly replaced by normal skin. Four months later the activity in the left knee seemed to have disappeared, and the splint was discarded. Shortly afterwards a large mass of adenoids was removed. Two months later, the left knee swelled again, and in a further two months the knees became normal again, though some wasting of the left thigh persisted. During the next five months no recurrence took place, and then an effusion appeared in the left knee and in the right ankle.

At this stage the patient came under my notice, and, impressed by the chronicity of the condition, the failure to respond to salicylates, the painlessness of the condition, the remissions of the disease in spite of the absence of immobilization, and the failure of the disease to get worse in spite of the fact that she had been walking about, I strongly suspected syphilis, and dismissed the diagnosis of tuberculosis. A Wassermann reaction proved to be strongly positive, and mercury and potassium iodide were administered. These did no good, and the child was admitted to hospital and given a course of N.A.B. Under this treatment the whole of the swelling rapidly disappeared, and the appearance of the limbs became normal. This was in November, 1924, and no recurrence has taken place since.

2. In adults a number of scattered cases have been recorded in which the simulation of acute rheumatism has been very close. The disease occurs

in young adults; several joints become affected in rapid succession; there is often considerable pain, increased by movement of the joints or pressure upon them; and the joints themselves are very tender, swollen, and red; the temperature may be raised considerably, even up to 103° or 104° . Anæmia and copious sweating complete a picture which is practically indistinguishable, at first sight, from that of acute articular rheumatism. There may be no other signs of syphilis to point to the proper diagnosis. The administration of salicylates, however, does no good, the Wassermann reaction is found to be strongly positive, in some cases iritis or some other manifestation of syphilis may appear, and—most important of all—treatment with neo-salvarsan or some other arsenical derivative produces a rapid and permanent cure. Though these cases are rare, it is important to be aware of their existence, and not to persist in the diagnosis of acute articular rheumatism in a case in which the recognized treatment for that condition fails.

CLINICAL APHORISM No. 5.—*Acute rheumatism which does not react to salicylates is almost certainly syphilis.*

THE PSEUDO-RHEUMATOID FORM.

Occasionally one meets a case of what seems, clinically, to be typical rheumatoid arthritis, with radish-shaped fingers, pyrexia, sweating, pain, debility, intermittent pyrexia with exacerbations and remissions of the disease, etc. The simulation of rheumatoid disease is complete, and it is only by carrying out the Wassermann test in every one of these cases, and treating



FIG. 162.—Pseudo-rheumatoid form of syphilitic arthritis.

those patients who give a positive result with antisyphilitic remedies, that the true diagnosis can be made. In a small proportion of these cases, treatment by '606' or the like effects a rapid and absolutely permanent cure, which seems to prove conclusively that the disease is not rheumatoid arthritis but a form of syphilitic arthritis.

The patient whose hands are illustrated in Fig. 162 was seen by me at

Guy's Hospital some fourteen years ago. She had been treated for some time for ordinary rheumatoid arthritis, without the slightest result. At that time, impressed by the case of M. E. K., quoted above, I was making a routine investigation of each and every case of arthritis, no matter what its nature, which I had the opportunity of examining. In this case, to my great surprise, a strongly positive Wassermann reaction was obtained; I regarded the case, quite naturally, as one of rheumatoid arthritis occurring in a patient who chanced to be syphilitic; but, thinking it worth while to follow the matter up, I got her admitted, and treated with '606', which was then a comparatively new drug in this country. The surprise of everyone was very great when the swelling of the hands and all other manifestations of rheumatoid disease disappeared completely within three days; I watched this patient for two years afterwards, during which time the Wassermann reaction remained negative, and no further symptoms of any kind appeared.

Brouardel also mentions the case of a man of 55 years, who contracted syphilis at the age of 17 years, and was married at 23. At 49 years he complained of slight stiffness of the spine; at 53 years he had a pain in the arch of his instep when walking. A year later he was unable to walk, owing to the stiffness of his tarsus. His spine was rigid, especially in the lumbar region; both his ankles were swollen and globular, and X rays showed a bone lesion to be present. Though movements were decreased in range, the joints were not at all tender. His knees now became swollen, and the diagnosis made was chronic rheumatoid arthritis. In view, however, of the history of syphilis, and the fact that one of his children had been born dead, a course of mercury cyanide injections was given, and he began to walk again after six weeks, eventually recovering completely.

The Pseudo-tuberculous Forms.—These have been described in passing, under their various headings, and it is only necessary here to enumerate them. They include: chronic hydrarthrosis; chronic plastic arthritis; chronic gummatous perisynovitis (pseudo-tumor-albus); chronic gummatous arthritis with bone changes and a tendency to ankylosis; chronic quiet ankylosing arthritis; chronic suppurating arthritis.

Suppurative Forms.—In congenital syphilis, aseptic necrosis may occur, and the results of the necrotic process may be discharged as a kind of pus. In other cases, ordinary secondary bacterial infection takes place.

In tertiary syphilis the suppuration is sometimes the end-result of severe gummatous arthritis.

GENERAL DIAGNOSIS.

The Family History must be fully considered; and in particular the history of repeated miscarriages during early married life is significant. In a really typical case it may be found that first of all the mother miscarries, during early pregnancy; later, during the later months of pregnancy; then she gives birth to a child which dies, within the first few days, of obvious congenital syphilis; and later, the children, though puny, survive for a time, only to die of some intercurrent malady. But it must also be remembered that a history of predisposition to tuberculosis may be misleading. For

example, in one case which was eventually proved to be unquestionably one of syphilitic arthritis, the issue was confused for a long time owing to the fact that the patient's mother and sister had both died of phthisis.

Previous Diseases will also be investigated, especially as regards the occurrence of interstitial keratitis, iritis, chronic glandular enlargement, etc. A negative history as regards the primary lesion, in acquired cases, is of no importance whatever, as mentioned above. The absence of any history or evidence of collateral syphilitic lesion, in a case of suspected syphilitic arthritis, need not deter one at all from the diagnosis, for in many cases no other lesions develop, whilst in others they only develop at some later date.

History of Present Condition.—A history of recurring attacks of painless joint-swelling which does not respond to salicylates or other treatment is in itself highly suggestive. If there be pain considerably worse at night (osteocopic), this is still more suggestive. In a person who has had syphilis, the occurrence of a blow may precipitate the onset of an arthritis, just as it does in tuberculosis; and one must guard against the error of over-stressing the importance of this history, and more or less assuming, on this account alone, that the case is one of tuberculosis. In any case in which an arthritis follows a blow upon a joint, in a patient supposed to be syphilitic, the possibility of the arthritis itself being syphilitic should be considered.

The Wassermann Reaction.—

CLINICAL APHORISM No. 6.—*The Wassermann reaction should be tested as an absolute routine in every case of arthritis of every degree of severity.*

Neglect of this rule has been the cause of a large number of cases of syphilitic arthritis being overlooked in the past. To carry out a serum reaction in every case of arthritis should be just as much a matter of routine as is the carrying out of an X-ray examination and a test meal in every case of chronic dyspepsia, and no great progress in the diagnosis and treatment of syphilitic arthritis can be anticipated until this rule is universally adopted *and taught*. It is necessary to test both the blood-serum and the joint-fluid, if the latter be obtainable. In a number of cases a positive result will be obtained from the joint-fluid when the blood-serum gives a negative result. This fact also should be more widely appreciated. Even in clinics where the Wassermann reaction is tested as a routine in every case of arthritis, unfortunately one still finds, in many instances, that only the blood is tested. Of course, if the reaction is positive in the blood, this will suffice, but a negative finding in the blood does not negative the possibility of syphilitic arthritis, and a joint-puncture should be made in all such cases. I have repeatedly demonstrated this in cases that were presented to me as being unquestionably 'negative'. In cases of simple syphilitic synovitis, the joint-fluid may be straw-coloured and fairly limpid, though sometimes it is rather thready; it is coagulable, and as a rule at this stage its Wassermann reaction is strongly positive. In the later stages the fluid is usually more curdy, and may be quite thready, or even turbid, whilst under the microscope it is found to contain a fairly large proportion of lymphocytes, i.e., about as many lymphocytes as there are polymorphs. In these cases it is necessary to use an aspirating

needle of quite wide bore, or else no fluid will be obtained for examination. The absence of micro-organisms, both on direct examination and on culture, is, of course, of some importance in the differential diagnosis.

In the later stages of congenital syphilis the Wassermann reaction will sometimes be found to be negative, though the arthritis has not fully subsided; it must not be assumed, however, that the arthritis is not syphilitic, for (1) it may be found at a later date that the Wassermann action is again positive, and (2) antisyphilitic treatment may effect obvious improvement in the condition of the joint. In other words, a negative Wassermann reaction cannot be assumed to exclude the possibility of syphilitic arthritis, in cases of late congenital syphilis, at any rate until the effect of a course of antisyphilitic treatment has been tried. As a corollary to this, one might add that in all cases in which the diagnosis of a case of arthritis has remained obscure, in spite of every possible investigation, it is worth while to try the effect of antisyphilitic remedies. Occasionally a dramatic cure ensues, as, for example, in that of the woman previously mentioned who appeared to be suffering from very typical rheumatoid arthritis of the hands, knees, and other parts, in whom a cure, apparently permanent, was effected after a short course of '606'.

Clinical Details.—In regard to these, certain features may be stressed, and particularly:—

Painlessness, in spite of profuse hydrops, especially when this is associated with a perfectly free range of movement.

Symmetrical synovitis.

General health unimpaired in many cases in spite of prolonged joint affection.

Failure to respond to certain specific drugs, e.g., salicylates.

Persistence of the condition in spite of treatment that would be successful in other conditions—rheumatism, rheumatoid arthritis, tuberculosis, etc.

Osteocopic pain.

Associated evidence of syphilis.

Failure to produce tuberculosis, after injection into a guinea-pig of some of the aspirated joint-fluid, may be of assistance in the differential diagnosis.

X-ray Examinations reveal, as a rule, no abnormality in cases of simple syphilitic synovitis or hydrops. In the tertiary stage of syphilis, however, there are usually well-marked changes, viz., those characteristic of ulceration of the articular cartilages, and inflammation and erosion of the underlying bones. As a rule, as in ordinary osteo-arthritis, the changes are proliferative at the margins of the articular surfaces, and destructive over the pressure-surfaces. As a rule there are irregular and often more or less pointed osteophytes projecting from the edges of the articular surfaces, and upon the whole these are less well defined in outline than are the osteophytes of ordinary osteo-arthritis. Occasionally one sees deep and well-defined local pitting of the bone in syphilitic osteitis, and when this occurs it is very characteristic. In the lower end of the femur, or in the head of the tibia, for example, one may see little rounded cavities, just under the articular surface, of a size that would about accommodate a good-sized pea. In adults there is very often a considerable amount of periostitis associated with the arthritis

properly so-called, and, to anyone who has learnt to recognize by experience the characteristic appearance of syphilitic periostitis in a radiogram, the diagnosis of the arthritis itself is pretty obvious. It is rather difficult to describe the appearance of syphilitic periostitis, but some idea may be given by saying that it generally looks as if the negative had been striped longitudinally, along the diaphysis only, with a soft black crayon, or perhaps an artist's charcoal: and as a rule it is the whole circumference of the bone that is involved, and not only one aspect, as occurs in traumatic periostitis. Moreover, in the latter condition the deposit of new bone is generally more dense and more localized than in syphilitic periostitis, and the pencilling looks as if it had been done with a fine HB pencil rather than with a soft crayon. In other words, the new bone in traumatic periostitis is much more compact in texture than is that seen in syphilitic periostitis.

In children and adolescents the X-ray appearance is usually one of arthritis only, and in many cases, though the changes are obvious enough, it is difficult or impossible to say whether they are those of half-healed tuberculosis or of syphilis. In the knee, for example, one often meets cases in which the articular cartilage has been ulcerated away, the joint surfaces are fuzzy and irregular, there is a certain amount of general porosity of the bones, but no attempt at ankylosis, and one is left in doubt as to the correct diagnosis. In short, X-ray examination is not very helpful in many of these cases, save that it differentiates at once between syphilis and sarcoma.

RESULTS OF ANTISYPHILITIC TREATMENT.

Speaking in general terms, one may say that the earlier the case is diagnosed, the better is the prognosis. Cases of symmetrical synovitis (Clutton's joints) are easily and permanently cured, as a rule, by a short course of antisyphilitic treatment; occasionally, however, one meets one that is very resistant and tends to relapse. The early tertiary lesions often do very well, if diagnosed early and treated vigorously; and even late cases respond, now and again, in a most surprising way. Roberts, for example, mentions three cases that were successfully cured after having been wrongly diagnosed and wrongly treated for a number of years: in two knee cases of six years' and ten years' duration respectively, nearly normal function was recovered, and some necrotic bone foci regenerated entirely; another patient, who had had hip trouble and constant pain for twenty-five years, described himself as being "entirely comfortable" after only ten days' treatment. These cases, however, are fortunate exceptions, and as a rule it must be confessed that, where the syphilis has reached an advanced stage, the cure of the joint will be slower and less perfect, whilst the prospect of a real and lasting cure becomes correspondingly remote.

Some of the most disappointing cases occur in tertiary syphilis in older children. They drift on, becoming neither well nor markedly worse, for a number of years, and relapse from time to time; they are even more chronic than some of the worst tuberculous cases. Sometimes the disease persists in spite of the most assiduous treatment of every kind, and the joint (very often a knee) remains in an exasperating half-healed condition, neither

resolving nor ankylosing, but persisting in a sort of mid-way condition, periodically becoming swollen, painful, or flexed; consequently, these patients have to be treated in caliper splints for a great number of years, for experience has shown that, apart from its undesirability upon general principles, excision is unsafe in these cases, owing to the risk of failure of bony union. Roberts mentions a series of 51 cases diagnosed as tuberculous by competent surgeons, and treated as such for periods up to fifteen years; 26 of these cases were completely cured when appropriate antisyphilitic remedies were administered, so that the advisability of routine Wassermann examination and of the routine administration of antisyphilitic remedies in all cases of arthritis defying diagnosis is abundantly demonstrated. Still, to be quite frank, the results of antisyphilitic treatment at a fairly late stage of the disease are, upon the whole, disappointing, so that our main hope for the prevention of this most disabling disease lies in the direction of earlier and better diagnosis. There is a most impressive contrast between the rapid and complete cure that can be effected in cases of syphilitic arthritis diagnosed in early childhood, and the years of crippling, pain, and deformity that may be inflicted if the diagnosis is missed.

CONCLUSIONS.

1. Syphilitic arthritis is not nearly as uncommon as it is commonly thought to be.

2. There are many forms of syphilitic arthritis, undoubtedly syphilitic, that are not generally recognized, chiefly because the possibility is never entertained when the diagnosis is being made. Some of them closely mimic other commoner conditions.

3. It is very important to diagnose these cases, and to diagnose them early, because tremendous suffering, danger, crippling, etc., are otherwise involved.

4. In every joint-case, of whatever kind, the possibility of syphilis should be considered and investigated.

5. *Most important of all, a joint-puncture, with Wassermann reaction and cytological examination of the fluid, and a Wassermann reaction of the blood, should be done as a routine in every case of arthritis of every kind.*

6. If the case remains undiagnosed after all possible investigation, the effect of a course of antisyphilitic treatment should be tried.

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THE SO-CALLED BRANCHIOGENETIC CARCINOMA: ITS OCCUPATIONAL INCIDENCE AND ORIGIN.

By RUPERT VAUGHAN HUDSON, LONDON.

AMONG cases of malignant disease there occasionally occur patients who present themselves with a tumour of the neck and in whom, on careful examination, no discoverable focus of disease can be found. The tumour has the microscopical characters of a squamous carcinoma. In such cases the diagnosis rests between a primary carcinoma of branchiogenetic origin and a carcinoma secondary to a healed or undiscovered focus somewhere in the body.

Many such cases have been recorded in the past, and much controversy has arisen as to their mode of origin. In modern text-books, with the exception of Ewing's *Pathology*¹ and Choyce's *System of Surgery* (Arthur Edmunds², Raymond Johnson³), the information upon these cases is scanty. No consensus of opinion exists concerning them, and some authors deny that vestigial remnants can give rise to a malignant tumour. The prevalent opinion, however, with regard to these apparently primary tumours of the neck may be briefly summarized as follows: (1) A solid malignant tumour of the neck showing the structure of a squamous-celled carcinoma is most probably secondary to a healed or undiscovered focus somewhere in the immediate vicinity. (2) A tumour originating in vestigial remnant is rare, but occurs in two main types: (a) The branchiogenetic carcinoma; (b) The so-called endothelioma; the former manifesting itself as a malignant swelling in which fluctuation can be detected, and having on section the structure of a squamous-celled carcinoma arising in a pre-existing cyst; the latter as a solid malignant swelling showing the structure common to the endothelioma of the parotid and the submaxillary glands. The unusually early onset of secondary glandular infection may mislead the diagnostician. Ewing emphasizes the fact that branchiogenetic carcinoma when it occurs is commonly cystic, but admits the possibility of a solid squamous-celled carcinoma of branchiogenetic origin.

PARTICULARS OF CASES.

At the Middlesex Hospital during the last two years there have been no fewer than 10 cases of carcinomatous cervical tumour of obscure origin. Of these cases 4 are still under observation, and may be presumed to be of the same nature; but as the remaining 6 appear to fall into one anatomical, pathological, and etiological group, they are here recorded in detail. The most striking fact which emerges is the occupational incidence of these growths, for they all occurred in miners or grooms.

These tumours each began as a small painless swelling just below and behind the angle of the mandible. The gradual increase in size of the swelling

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eventually compelled the patient to seek advice for pain, which was not local, but referred to the temporal region and back of the neck. On examination, the only positive clinical sign was the presence of an ovoid tumour, regular in outline, and firmly fixed to the skin and deep structures. The centre of the growth lay just below and behind the angle of the jaw, and the tumour extended upwards, filling the natural hollow between the upper third of the sternomastoid and the ascending ramus of the mandible, but not interfering with the movement of this structure. In spite of rhinolaryngoscopy, no primary focus was then to be found. Microscopy revealed the fact that the tumours were squamous in origin.

They were all treated by the insertion of radium, contained in platinum tubes 2 to 3 cm. long, and of a wall thickness which varied from 0.3 to 0.5 mm. The tubes carried quantities varying from 10 to 50 mgrm. of radium bromide, and were sometimes used with additional $\frac{1}{2}$ -mm. screens.

The following are the records of these cases. The photographs and diagrams (tracings of actual photographs) are so arranged that the treatment and clinical course of each patient may be more easily and rapidly followed.



FIG. 163.—Case 1. July 21, 1924. Left side, showing the tumour site measuring 9×6 cm. The stitches mark the insertion of the radium tubes.

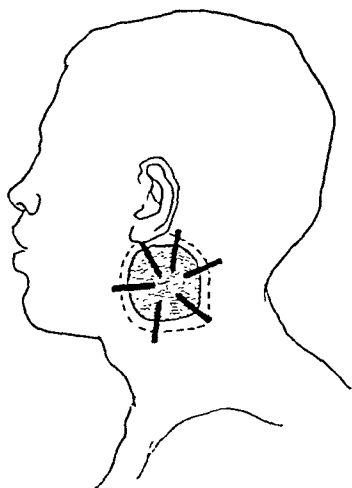


FIG. 164.—Case 1. Sept. 1, 1924. The tumour is smaller. Three tubes of 25 mgrm. and three tubes of 50 mgrm., without additional screens, were inserted radially.

Case 1. (Under the care of Mr. A. E. Webb-Johnson.)—E. T., a boy, age 19, who had been occupied as a miner for the last five years. In July, 1924, a year before admission, he had noticed a painless small swelling behind the angle of the jaw on the left side. On admission he presented a large fixed, non-ulcerated mass in the left post-ramal recess. This mass was smooth and regular, and measured 9×6 cm. (Fig. 163). Below it, and at the crossing of the posterior belly of the omohyoid beneath the sternomastoid, was a small, soft, mobile gland. The only indication of a primary focus was a suspicious roughening in the posterior nares.

The microscopical picture showed the growth to consist of large masses of carcinomatous cells of squamous origin invading lymphatic tissue. No keratinization and no prickle cells were present.

TREATMENT.—Three tubes of 50 mgrm., plus three tubes of 25 mgrm., were placed $\frac{1}{4}$ to $\frac{1}{2}$ in. below the skin surface, and the tubes were distributed radially at the periphery of the tumour for twenty-four hours. No screens were used. The sentinel gland was excised.

Seven weeks later the irradiated area was flat and healed, but there was a suspicion of growth remaining at its upper pole and deep in the carotid triangle. In the corresponding site on the right side was a soft mass of fixed glands at the superior cornu of the hyoid bone. The original site was re-irradiated for thirty hours with six unscreened tubes, each containing 50 mgrm. (*Fig. 164*). These were placed $\frac{1}{4}$ to $\frac{1}{2}$ in. below the skin surface, and radially distributed at the tumour periphery between the scars of sites of the application of the former tubes. The soft mass of glands on the right side was surgically removed, and 100 mgrm. of radium were laid in the wound for thirty hours.

AFTER-HISTORY.—Two months later, and four months from the time when first seen, the irradiated site on the left side was a firm, flat, fibrous but flexible area, with no trace of growth. Above it, the pre-auricular gland was enlarged to the size of a hazel nut, soft and just movable, while below it, and at the site of excision of the sentinel gland, were three large, soft, mobile glands. On the right side in the post-ramal recess, the site of radio-surgical interference, there was a large fixed mass measuring 6×5 cm. The mouth was able to be opened only 3 cm. Mouth-breathing was definitely established, but, owing to the difficulty of access, a rhinological examination and report were deferred until an anæsthetic was given. No further treatment, however, was considered advisable, and the patient was discharged.

Five months later, and nine months from the day of the initial treatment, the patient was re-admitted. He had lost considerable weight and there was obvious mouth-breathing. The growth was filling the posterior nares and left antrum, and bulging in the soft and hard palate. The left

side of the face was firmly œdematous, obscuring the parotid from palpation. The irradiated site on the left side was still free from growth, but the pre-auricular gland above it was greatly enlarged, while the left subclavian triangle below it was full of large, soft, mobile glands (*Fig. 165*). On the right side the mass in the right post-ramal region now measured 9×5 cm., and below it were several large, soft, mobile glands. Swallowing was difficult and breathing stertorous, both no doubt due to the post-nasal growth.

Death occurred at home from inanition two years after the onset of the disease and eleven months after the initial treatment. No post-mortem was available.

The primary lesion here was apparently in the posterior nares, but did not make itself clinically manifest until fourteen months after commencement of the enlargement of glands draining the area.

The clinical course of this case differs from the others of this series. The primary focus was paramedian, and, owing to the local extension of the growth towards the middle line and the lymphatic decussation of the site.

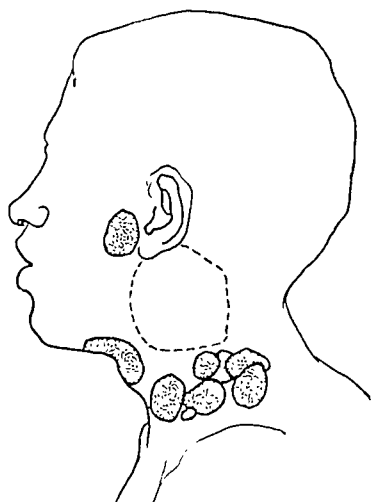


FIG. 165.—*Case 1.* March 1, 1925. Left side. The original tumour site free of growth. The glands below it greatly increased in size and number. The pre-auricular gland further enlarged. Growth is filling the posterior nares and left antrum.

the cervical glands were invaded on both sides of the neck. With the exception of this fixed original mass, the cervical glandular enlargements were always discrete, soft, mobile, and large, but were non-adherent (except slightly to one another) to surrounding structures. Clinically they mimicked the glandular enlargement of Hodgkin's disease.

As regards treatment, several valuable lessons were derived from this case. It was possible, without skin damage or necrosis of subcutaneous tissue, to apply three tubes of 25 mgrm. and three tubes of 50 mgrm., unscreened, for twenty-four hours radially at the periphery of a circle 5 cm. in diameter. Seven weeks later it was possible, again without damage to the skin or subcutaneous tissue, to apply six tubes of 50 mgrm., unscreened, for as long as thirty hours radially at the periphery of the same circle. In both applications the tubes were $\frac{1}{4}$ to $\frac{1}{2}$ in. below the skin surface. After the first dose growth was active in the depth of the tumour and at its upper pole, both areas corresponding to the site of least irradiation. The subsequent dose was introduced during the stage of retardation, and, as a consequence, the growth further retrogressed and eventually disappeared entirely. In comparison with previous dosage used this is enormous, but was only just sufficient to effect its purpose, and did so without damage to normal structures.

On the right side, where radium and surgery were used in combination, the results were not to be compared with the result obtained by irradiation alone upon the left side, a fact which confirms the writer's impression that trauma of a malignant site before irradiation is harmful, whether the trauma is surgical, infective, or caused by the unintentional massage by repeated examination. Procedures likely to destroy the normal healthy tissue at the periphery of the tumour will greatly reduce the value of subsequent immediate radium therapy.

Although the original mass, 9×6 cm., was apparently destroyed *in vivo* by radium, there was no immunizing effect from the dying cells of the region.

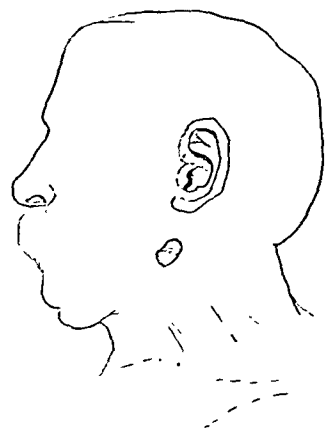


FIG. 166.—Case 2. April, 1924: onset.

Case 2. (Under the care of Mr. Sampson Handley.)—M. S., age 65, had been occupied as a miner all his life. In April, 1924, eight months before admission, he had noticed a painless swelling below and behind the angle of the jaw on the left side (Fig. 166). He presented himself with a large, oval, non-ulcerated, fixed mass, measuring 12×11 cm. (Fig. 167), whose centre lay in the left post-ramal recess, but extended to the mastoid process above, to the level of the thyroid below, and laterally into the posterior triangle. In the centre of the tumour the skin was red and shiny; fluctuation could be detected. The patient's general condition was fair, but he suffered great pain in the head and back of the neck, preventing sleep. He had lost 2 stone in the last six months. No other glands were clinically involved, nor was any primary focus to be found.

TREATMENT.—Under an anæsthetic a quantity of broken-down growth and brown semi-fluid material was removed. Four tubes containing 50 mgrm. of radium

bromide and screened by additional platinum 0.5 mm. thick were placed radially in the centre of the growth for twenty-four hours, and a portion of the growth was removed for microscopy. (*Fig. 168.*)



FIG. 167.—Case 2. October, 1924. Site of tumour measuring 12×11 cm.

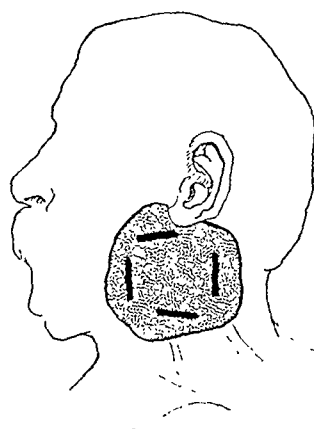


FIG. 168.—Case 2. October, 1924. Treatment: a quantity of broken-down growth evacuated, and four 50-mgrm. tubes of radium inserted.

The microscopical section showed a squamous-celled carcinoma arranged for the most part in fine intercommunicating strands. Definite prickles could be found, but there was no keratinization. Numerous mitotic figures were present.

AFTER-HISTORY.—The patient was discharged; he was still in pain and only slightly relieved by treatment. A letter was received to state that he had died in April, 1924, a year after the onset of his symptoms. No post-mortem was available, and a further search for a primary focus was therefore not possible.

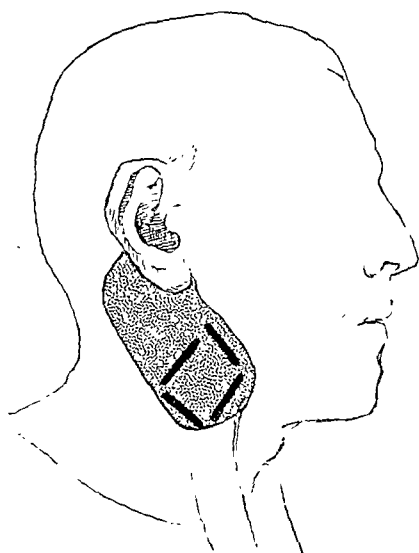


FIG. 169.—Case 3. December, 1924. Four 50-mgrm. radium tubes arranged round the caudal half of the tumour.

In this case radium was used with the hope that the pain might be relieved; unfortunately the alleviation of symptoms was not very marked. The case is illustrative of the later stages of these growths and their tendency to remain localized at the site of origin.

Case 3. (Under the care of Mr. Eric Pearce Gould.)—C. R., age 55, had worked with horses all his life. In July, 1924, six months before admission, he had noticed a painless swelling behind the angle of the jaw on the right side. He presented himself with an obvious cervical swelling, oval, regular, and firm, measuring 6×9 cm., and situated in the right post-ramal recess. It was adherent to the skin, which showed

peau d'orange over the centre of the growth; the skin was intact. It was adherent to and fixed to the structures beneath, and in the sternomastoid muscle at that level. It was not adherent to the jaw, nor did it interfere with that structure's mobility. No glands were palpable elsewhere, and no primary focus was found either locally or elsewhere in the body. On rhinolaryngoscopy, no primary focus was to be seen.

TREATMENT.—Four tubes of 50 mgm. of radium bromide, unscreened by additional platinum, were buried in the form of an open square round the caudal half of the tumour for sixteen hours (*Fig. 169*). The upper half was not irradiated. A portion of the tumour removed proved microscopically to be a squamous-celled carcinoma. Prickle cells, but no cell nests, were present. In three months the irradiated half of the tumour had shrunk considerably; the upper half had slightly increased in size. Further treatment was refused by the patient owing to fear of losing his present work.

AFTER - HISTORY.—In a further three months the region irradiated was still smaller than when first seen, but the non-irradiated area had quadrupled its size (*Fig. 170*), and the whole mass was now 18×27 cm., not ulcerated, but adherent to all the neighbouring structures, producing a facial palsy and interfering with mandibular movement.

The condition was too far advanced for any further treatment, and the patient was admitted to the inoperable cancer wards, where he died in November, 1925, fourteen months after the first onset of symptoms.

At the post-mortem, externally the growth was found to have extended peripherally, while in the centre the skin was invaded and showed an ulcer 3×3 cm. Extension had chiefly taken place along the carotid vessels to the base of the skull, and solid growth was bulging the right tonsil and right nasopharynx towards the middle line, but the mucous membrane was not ulcerated. Growth towards the clavicle had not progressed beyond the thyroid level. The primary focus was found, and proved to be in the right pyriform fossa (*Fig. 171*), where there was a small shallow ulcer, 2×2 mm., having just above it a small, soft, sessile, malignant, papillomatous growth measuring 5×5 mm. No other metastases were found. Death was due to bronchopneumonia. Microscopically both the ulcer and the papilloma proved to be definite squamous-celled carcinoma.



FIG. 171.—Case 3. November, 1925. The site of primary growth. An ulcer and papilloma in the right pyriform fossa. (The œsophagus has been slit on its dorsal aspect.)



FIG. 170.—Case 3. July, 1925. Showing increase in size of tumour. Note irradiated site apparently still free of growth.

Only half the actual mass of this tumour was encircled by radium. The tubes were concentrated into a comparatively small area and for a short time. In

three months the area of tumour actually irradiated had shrunk considerably. This tumour therefore was susceptible to radium. The upper half of the tumour, which was juxta-tubal but not encircled, was growing, but, judging by the rate of growth from onset to admission (five months), at a much reduced rate. We have therefore a decrease in the encircled area and retardation of the growth at the periphery. In a further three months (six months since the day of treatment) we have, in place of the original tumour, a mass roughly three and a half times the original size, lying in the form of a crescent and apparently originating in the upper half of the tumour; growth has therefore become suddenly rapid.

Case 4. (Under the care of Mr. W. Turner Warwick.)—R. L., age 62, had been occupied as a groom all his life. In February, 1924, he noticed a painless swelling behind the angle of the jaw on the right side. He presented himself with an obvious cervical tumour, a firm, regular mass 9×6 cm., situated in the post-ramal recess on

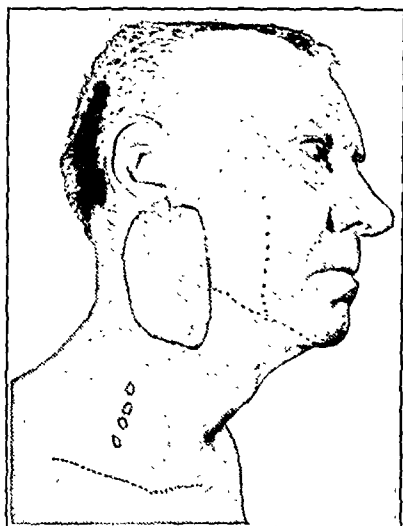


FIG. 172.—*Case 4.* December, 1924. Site of tumour and glands. The dotted lines mark the horizontal ramus of the mandible, the anterior border of the masseter, and the clavicle.

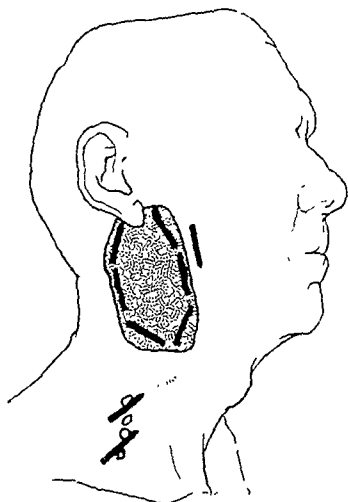


FIG. 173.—*Case 4.* December, 1924. Six tubes of 50 mgrm. and one of 90 mgrm. arranged parallel to and within the tumour periphery. Glands treated by two tubes of 37 mgrm.

the right side. It was adherent to skin over its centre, *peau d'orange* being present. The skin was intact and non-ulcerated. It was adherent to the carotid sheath and fixed in the sternomastoid muscle. It was not adherent to the ramus of the jaw, nor was that structure interfered with as regards its mobility. There were four small glands parallel to and just behind the posterior border of the sternomastoid, the centre gland being just above the posterior belly of the omohyoid muscle (Fig. 172). These glands were discrete, firm, mobile, and easily palpable. There was one soft gland in the right axilla. No primary focus could be found on rhinolaryngoscopy.

TREATMENT.—Six tubes containing 50 mgrm. of radium bromide and one tube of 90 mgrm., without additional screens, were inserted for thirty hours (Fig. 173). The tubes were buried $\frac{3}{4}$ to $\frac{1}{2}$ in. beneath the skin, and arranged round the growth, but $\frac{1}{4}$ in. inside its palpable margin. Two tubes each containing 37 mgrm. of radium

bromide, without additional screens, were placed for eighteen hours over the mobile, discrete glands in the neck. The time was shortened in this case to eighteen hours, as it was impossible to implant the tubes at a deeper level below the skin than $\frac{1}{8}$ in. Convalescence was good and uneventful. During the patient's five days' stay in hospital there was a fair reaction and slight increase in the size of the tumour, as is often the case at first.

The section showed a squamous-celled carcinoma involving lymphoid tissue. The cells were arranged in strands; definite prickles were present, together with keratinization and cell nests. Mitotic figures were numerous.

Six months after treatment the patient attended hospital and it was found that there was marked improvement. The skin was epilated, smooth scar tissue. The sternomastoid was movable in its whole length; all that could be felt was a hard, fibrous mass at the junction of the upper third and middle third of the sternomastoid on its medial edge. The size of this fibrous mass was about 2×2 cm. and its position was opposite the angle of the jaw. The glands had disappeared, but there was slight induration present. There were no other glands palpable elsewhere, and no signs of mediastinal involvement.

The patient was advised to seek admission for second rhinolaryngoscopic examination, and further radium treatment. It is interesting to note that the residual growth of 2×2 cm. was situated at the site of minimum radiation. On re-admission four tubes containing 50 mgrm. of radium bromide, without additional screening, were placed as follows: 50 mgrm. parallel to the posterior edge of the sternomastoid: three tubes of 50 mgrm. placed parallel to one another and horizontal to the sternomastoid muscle. The intervals between the tubes were 1.5 cm., and their depth below the skin surface was $\frac{1}{8}$ in. The duration of exposure was twenty-four hours.

For the following subsequent history of the case I am indebted to Dr. Goone Tilleke, the patient's doctor and the Medical Superintendent of the Highgate Hospital.

A week after leaving hospital, and eight days after the second application of radium, the patient developed very severe pains in the small of the back; these pains were excruciating, and radiated from the sacrum to the lower limbs. He was admitted to the Highgate Hospital, where he developed gangrene of both feet. A local recurrence developed at the irradiated site. Death occurred in May, 1925, ten months after the onset of disease. No post-mortem was performed, but death was attributed to his general condition, and not to the local recurrence.

Progress in this case had been satisfactory up to the time of the second irradiation, and the patient's sudden death after treatment was unexpected. It is evident that the first dose of irradiation was not sufficient to arrest the disease; whether the second irradiation was the accelerating cause or a contributory factor to this comparatively sudden death, it is difficult to state.

The re-irradiation of a region which has been treated by radium some months previously is always a difficult problem. The normal tissues and skin are less tolerant, but the neoplastic cells more tolerant, of irradiation; further, these cells are for the greater part lying in a mass of fibrous tissue which no doubt acts as an additional screening agent. It seems extremely important to deal with a given focus in one single dose, and, if repetition is considered likely, to repeat the second dose within a few weeks of the first, and preferably before the patient leaves hospital.

Case 5. (Under the care of Mr. Sampson Handley.)—G. K., age 58, had been occupied throughout his life as a groom. In November, 1924, five months before admission, he noticed a small painless lump about the size of a large marble behind the angle of the jaw on the left side. Recently he had suffered pain in the temporal

region. He presented himself with a round, hard, elastic, non-ulcerating, firm lump opposite and behind the angle of the jaw on the left side (*Fig. 174*). This tumour lay beneath the sternomastoid in its lateral half, and was intimately adherent to



FIG. 174.—Case 5. March, 1925. The tumour site is outlined, and the dotted line marks the ramus of the mandible and anterior margin of the masseter muscle.

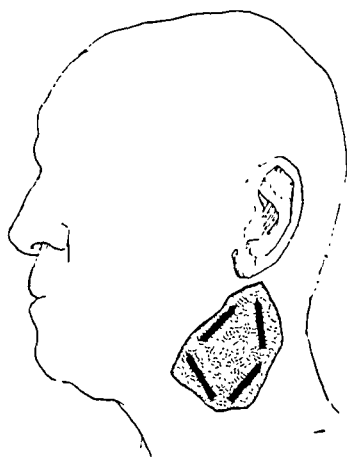


FIG. 175.—Case 5. March, 1925. Four tubes of 50 mgrm. inserted parallel to and within the periphery of the tumour.

that muscle. It was adherent to the skin, and was just movable laterally upon the carotid vessels, but not in their length. It measured 6×5 cm. No other glands were palpable and no primary focus could be found. A portion was removed for microscopy.

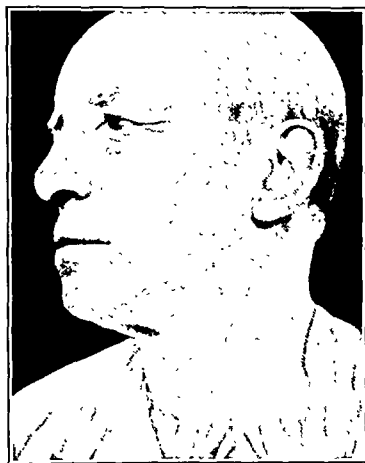


FIG. 176.—Case 5. April, 1926. There is no evidence of recurrence.

TREATMENT.—Four tubes each containing 50 mgrm. of radium bromide were placed just within the periphery of and encircling the tumours (*Fig. 175*). The duration of the exposure was twenty-four hours. No additional screens were used. The microscopical section shows a squamous-celled carcinoma invading lymphoid tissue; the malignant cells lay in irregular masses. Definite prickle cells were present, but no cell nests were to be seen.

AFTER-HISTORY.—Up to the present time (twelve months since treatment) all that remains of the tumour is a small fibrous mass, 1×1 cm., situated in the sternomastoid muscle and corresponding to the centre of the tumour (*Fig. 176*). No primary focus has yet been found.

This growth was the smallest and earliest of these series, and as a consequence irradiation was more likely to be effective. In the photograph of this patient the tumour appears a little lower in position than actually was the case; but invasion of the sternomastoid had taken place earlier, and was more marked than in the other tumours in these cases.

Case 6. (Under the care of Mr. Sampson Handley.)—T. R., a male of 66, who had been occupied as a groom and occasionally as a gardener all his life. In October, 1924, he noticed a painless swelling just behind the angle of the jaw on the left side. In July, 1925, he found difficulty in swallowing, and was admitted to a hospital, where the tumour was removed.

In October, 1925, three months later, he was admitted to the Middlesex Hospital with an irregular swelling in the post-ramal recess on the same side, extending from the cartilage of the ear above to the superior cornu of the hyoid bone below. The recurrence was hard, irregular, and nodular, adherent to the skin, but appeared just movable on the deep structures. It was not adherent to the ramus of the mandible. The left cord was paralysed and lay in the cadaveric position. There was some hoarseness of voice and difficulty in swallowing. No primary focus could be found on rhinolaryngoscopy.

TREATMENT.—The left sternomastoid, together with the fascia and glands, were removed, but a portion of the tumour was of necessity left behind. Radium was inserted at the time of the operation as follows: Two tubes of 50 mgrm. deep to the ascending ramus of the mandible: one tube of 50 mgrm. anterior to the masseter muscle at the angle of the jaw: one tube of 50 mgrm. at the site of the omohyoid tendon: one tube of 25 mgrm. at the sternoclavicular joint. All the tubes were screened by additional 0.5 platinum. The duration of the exposure was twenty-four hours.

Microscopically the section showed a carcinoma invading lymphoid tissue. The cells appeared to be squamous in type and lay in large masses. No cell nests nor prickly cells were seen. Mitotic figures were present, but not numerous.

AFTER-HISTORY.—The patient only recently left hospital; he is at present still under observation.

This case was the only one of the series in which dysphagia was noticed in the early stages. No doubt its presence signified that spread was occurring, chiefly towards the pharynx, and that there was proliferation of growth in the conduits between the concealed primary focus and the main gland affected. The early recurrence after an apparent complete removal is significant.

COMMENTS.

The Anatomical Site of the Tumour.—In all these cases the cervical tumour arose at the site of the jugulo-digastric gland. As the site of the gland has a great bearing upon the etiological and pathological course of these tumours, it may be useful to note a few of its essential anatomical features.

This gland is large, oval, and flattened, and measures on the average 2.5 cm. in length. It is situated upon the medial aspect of the great jugular vein, having its upper pole at the lower border of the posterior belly of the digastric muscle, and its lower pole opposite the tip of the superior cornu of the hyoid bone. It is placed, therefore, at a site which may be called the 'critical point of the neck', since here—within the space of 2 to 3 cm.—arises the vascular supply to the structures derived from the first five arches, and to this point converge not only the greater part of their venous drainage, but, what is more important, the lymphatic drainage also.

Its importance appears to be due to the fact that it lies in the route of, and forms the main collecting station for, the lymphatics derived from the external auditory meatus, the Eustachian tube, the nasopharynx, the tonsil, the tongue, and the epi-laryngeal structures, the pyriform fossa especially. The main routes of drainage apparently follow the routes of the ascending

A SUMMARY OF SIX CASES OF APPARENT

CASE	NAME	AGE	OCCUPATION	DURATION OF OCCUPATION	DATE OF ONSET	DATE OF ADMISSION	SIZE OF TUMOUR ON ADMISSION	DURATION OF ILLNESS BEFORE TREATMENT
1	E. T.	19	Miner	5 years	July, 1923	July, 1924	9 × 6 cm.	12 months
2	M. S.	65	Miner	All his life	April, 1924	Oct., 1924	12 × 11 cm.	6 months
3	T. R.	55	Groom	All his life	July, 1924	Dec., 1924	9 × 6 cm.	5 months
4	R. L.	62	Groom	All his life	July, 1924	Dec., 1924	9 × 6 cm.	5 months
5	G. R.	65	Groom	All his life	Nov., 1924	March, 1925	6 × 5 cm.	4 months
6	T. R.	66	Groom	All his life	Oct., 1924	July, 1925	Not known	8 months

pharyngeal, the palatal and tonsillar branches of the facial, the lingual, and the suprahyoid branches of the superior thyroid vessels.

Onset and Course.—In these cases growth appears to have commenced in this gland and steadily increased in size, maintaining until late its regularity. Growth is centrifugal, and in its cranial course gradually fills the space between the upper third of the sternomastoid laterally and the ascending ramus of the mandible medially. These two structures tend to limit its spread, and their constant movement aids the production of the ovoid form which these tumours maintain until a late stage in their development. Situated on the jugular vein, and beneath the deep fascia, it is free to extend laterally beneath the sternomastoid, medially towards the pharynx, and downwards into the neck, its upward spread chiefly running along the plane of the great vessels, the mastoid process and auditory meatus forming a strong buttress in the path of its more superficial route. Growth is no doubt directed mainly towards the softer structures of the pharynx, spread in this direction occurring beneath and being directed by the attachment of the deep fascia and the stylomandibular ligament to the mandible.

Site of Origin of the Primary Focus.—In only one of these cases was necropsy possible (*Case 3*), and in this case the primary focus was found in the pyriform fossa. In view of the size of the minute ulcer and small papilloma found, it is not surprising that during life this focus was overlooked, and no doubt at the time of examination the papilloma was not present; without it, even at careful necropsy, the ulcer might have been overlooked. In *Case 1* the clinical findings point definitely to the site of origin being in the posterior nares, and it is seen that there was only a detectable roughening at this site at the first examination, and it was not until six months later that the focus made itself definitely apparent.

PRIMARY MALIGNANT TUMOUR OF THE NECK.

HISTOLOGICAL PICTURE:	ULTIMATE FATE	PRIMARY FOCUS
reinoma, squamous in type : no prickle cells ; o cell nests	Died July, 1925	Posterior nares. Clinical proof. No post-mortem
reinoma, squamous in type : no cell nests ; prickle cells present	Died April, 1925	No primary focus found clinically. No post-mortem
reinoma, squamous-celled ; no cell nests ; prickle cells present	Died Nov., 1925	Post-mortem performed. Primary focus, sinus pyriformis
reinoma, squamous-celled ; cell nests ; prickle cells present	Died May, 1925	No post-mortem. No primary focus found clinically
reinoma, squamous in type ; no keratiniza- on ; prickle cells present	Alive and well	No primary focus found clinically
reinoma, squamous in type ; no cell nests ; o prickle cells	Alive	No primary focus found clinically

Necropsy was unfortunately unavailable in the remaining four cases. It may be emphasized here that it is the difficulty of obtaining post-mortem examination that has in the past led to the diagnosis of branchiogenetic carcinoma merely on the score of absence of a primary focus in life.

The Occupational Similarity.—It is interesting to note that the cases of this group occur either in miners or men who have worked with horses all their lives. The curious occupational similarity was so striking that a search was made in the hospital cancer and surgical register for further evidence of cases giving a similar clinical history and a corresponding anatomical site of growth. Three cases were found ; one occurred in an elderly miner, one in a young carter, and the third in a man who had worked with horses all his life, but prior to his death was occupied as an engineer.

The question immediately arises : Can there be any possible connection between the environment of these patients and their disease ? The miner works in a dust-laden atmosphere, and those who have groomed a horse will know that the groom also is subjected to continual chronic irritation of the respiratory tract. In both, as in all of us, the pyriform fossa can form the site of lodgement of a small foreign body, and is continually subjected to the stagnation of particles of swallowed salivary or nasal secretion. But of the two it is essentially the groom, who is in the habit of chewing either a wisp of straw or hay, or a few of the oats from his horse's feed, who is, in consequence, more liable to a lesion of this area or of the tonsil. It is feasible, therefore, to suggest that, in those occupations in which a certain anatomical tract is subjected to the continual risk of trauma, such a site must be regarded as a possible mode of entry by a common causal agent, either at the time of its production by actual inoculation or by a subsequent infection from the inspired or swallowed content of a pollen or dust-laden atmosphere.

Treatment.—With one exception these particular cases when first seen had received no treatment other than medical. In the exception a surgical removal had been performed at another hospital, and three months later this patient was admitted with a fair-sized recurrence at the operation site.

It may be stated now that the great majority of recorded cases of surgical removal are uniformly disappointing; recurrence is generally rapid and fatal, whether a local or drastic operation has been performed. The reason for these poor results appears to be due to two main facts: (1) The difficulty of early diagnosis owing to the site of the tumour; (2) The presence of a primary focus acting as a neoplastic cell *dépôt*.

An enlargement of this jugulo-digastric gland is most commonly due to the chronic infection, and the diagnosis of malignancy will only be suspected when the gland loses its mobility by its attachment to the great vessels upon which it lies. At this stage surgical removal without damage to the great vessels is difficult, but still possible. At a late stage the operation must be abandoned or the vessels resected with the growth. If either of these surgical feats is accomplished—and they have been in the past—it is evident that a large traumatized area is left behind, leading into which are the severed conduits of the primary focus which is still intact. Recurrence appears to be inevitable and it is rapid, since all fascial barriers have been removed and an excellent breeding ground for neoplastic cells is produced.

In the cases recorded here the question of operation did not occur; they were all hopelessly inoperable at the time when first seen, and the only possible course to pursue was either to refuse treatment, allowing them to die of their inevitably fatal disease, or to employ some form of X-ray or radiotherapeutic measure. The method chosen was radium.

In the treatment of these particular cases one had, therefore, to contend not only with the primary focus, but with a large mass of secondary growth. This volume of the tumour is extremely important from the point of radium therapy, as it is upon volume that the hope of correct dosage at present depends. The reason that this is emphasized is to draw attention, as has previously been shown, to the depth of the tumour and its liability to encroach upon the pharynx and travel towards the skull along the great vessels, so that always there is a tendency to under-estimation of the true size of the growth.

In examining the results of treatment in these cases it is seen that one is still alive and well, and that in another the original tumour-bearing site was apparently free from growth at the time of his death. With regard to the case that is still alive, only ten months have elapsed from the date of treatment, so that it is too early yet to draw definite conclusions; but it is significant that his tumour was the smallest of the series, having a surface measurement of 6×5 cm., giving a volume of roughly 150 c.c. The dose given was 200 mgrm. for twenty-four hours—an equivalent of over 1 mgrm. per 1 c.c. In the other case two applications were given to a tumour measuring 9×6 cm., whose volume was roughly 400 c.c. The first dose was 225 mgrm. for twenty-four hours, and the second 300 mgrm. for thirty hours, making a total of over 1 mgrm. per c.c.

Of the three other cases, in one the tumour was 12×11 cm. and too far advanced for any favourable result; the other two improved, and the growth

diminished in size for a time, but their dose appears totally inadequate, being roughly 1 mgrm. to 2 c.c. of tissue. In the future, should it be considered advisable to employ radium as a method of treatment, it appears that the best course to pursue is to compute as far as possible the correct volume of the malignant growth, and, owing to the depth of the tumour, to err on the generous rather than the meagre side: having obtained this volume, a total dose should be devised which approximates as far as possible to 1 mgrm. per c.c. for twenty-four hours. There are two methods of achieving this result: (1) By one or more doses using large tubes with a high radium content, the doses being repeated at relatively short intervals until the total amount is given; (2) The employment of small tubes of low radium content, leaving them in for a continual exposure of several days. Whichever method is used, it is essential to avoid normal tissue destruction and normal or tumour tissue necrosis—by screening to obviate the beta rays—and to produce uniform radiation to the deepest portion of the tumour that the anatomical structures will allow. Of the two methods outlined, the small needles and the long exposures appear to be the more suitable.

Diagnosis.—The diagnosis of these tumours rests principally upon their anatomical site and their consistency. The solid tumours that may occur at the same site are the primary endothelioma of lymph glands when it is of the single type, and the endothelioma of branchiogenetic origin; microscopic sections only will prove diagnosis. The solid tumours occurring near the site, in addition to the above-mentioned tumours, are the endothelioma and especially the carcinoma commencing in the lower pole of the parotid gland (*Fig. 177*); but these



FIG. 177.—Carcinoma of the lower pole of the parotid gland. (From a case under the care of Mr. Gordon-Taylor.)

growths are always at a higher level, more superficial, and spread in the parotid substance and cheek, as well as the post-ramal recess. Tumours of the carotid body are situated at a lower level and tend to be globular and early irregular in outline; their histological picture is definite.

All the above tumours are extremely rare. The growth most likely to give difficulty in diagnosis is the branchiogenetic carcinoma arising in a pre-existing cyst (*Fig. 178*), since its anatomical site and histological picture are somewhat similar; but it is again emphasized that the tumour is essentially cystic in some parts, and that it occurs at a lower and more median level in the neck.⁴

Early diagnosis will always be difficult, but the presence of a unilateral painless tumour at the site of the jugulo-digastric gland in an elderly man must be regarded with grave suspicion.

SUMMARY.

Six cases only have been recorded, and from so small a number it is unsound to draw too definite conclusions. It is submitted that these tumours form a definite etiological, pathological, and anatomical group:—

1. That they occur in those subjected to chronic irritation of the upper respiratory tract—in miners and workers amongst horses.



FIG. 178.—Showing the site of a branchial cyst. (From a case under the care of Mr Shorney Webb.) X marks the angle of the jaw. The upper dot in the middle line is opposite the centre of the body of the hyoid bone. The lower dot is opposite the centre of the notch of the thyroid cartilage. Note the lower level of the site of the cyst.

2. That they are derived from a primary focus in the region drained by the jugulo-digastric gland.

3. That their treatment is essentially by methods other than surgical, and at the present time, in the absence of a better therapeutic measure, radium is the method of choice.

4. That they are constantly being diagnosed erroneously as branchiogenetic in origin, and this has tended to bring the possibility of carcinoma arising in branchial remnants into disrepute.

5. That they may throw some light upon the pathway by which the causal agent of certain cases of malignant disease, and certain of the granulomas, gain an entry to the body.

I have to thank the Members of the Radium Committee of the Middlesex Hospital for their kind permission to publish these cases, and for their helpful criticism in the completion of this paper.

Particularly are my very grateful thanks due to Mr. Sampson Handley for his helpful advice and criticism.

My thanks are also due to Miss D. Clephan for photographing and carrying out the diagrams of these cases to my design.

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² EDMUND, ARTHUR, *Choyce's System of Surgery*, iii, 206.

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⁴ BAILEY, HAMILTON, "The Clinical Aspect of Branchial Cysts", *Brit. Jour. Surg.*, 1923, April, 565.

⁵ HANDLEY, SAMPSON, "The Encirclement Method of Using Buried Radium Tubes", *Brit. Jour. of Radiol.*, 1925, Nov., 422.

THE IMPORTANCE OF TOXÆMIA DUE TO ANAEROBIC ORGANISMS IN INTESTINAL OBSTRUCTION AND PERITONITIS.*

A clinical and experimental investigation, with the results of treatment with the appropriate antiserum.

BY B. W. WILLIAMS, LONDON.

INTRODUCTION.

THE similarity between the general clinical manifestations of cases of acute peritonitis and acute obstruction is, I think, widely admitted. In most fatal cases of acute peritonitis paralytic obstruction of the intestine develops secondarily, and it is this obstruction which produces the characteristic clinical aspect in the later stages. Taking the features common to the two conditions, though there is variation in individual intensity, collectively they bear a striking resemblance to the clinical features of the toxæmia associated with gas gangrene.

In the report of the Committee upon Anaerobic Bacteria and Infections published by the Medical Research Council the clinical aspect of anaerobic toxæmia resulting from war wounds is described as follows: "Vomiting is frequent . . . the pulse becomes rapid and is finally uncountable . . . the extremities are cold and blue, and the temperature falls. . . . It is a remarkable fact that the mind remains acute even to the end. In the terminal stages some degree of general icterus may be present".¹

It is interesting to compare this with the descriptions in a standard text-book of the clinical aspect of late cases of intestinal obstruction, or peritonitis. In a well-known manual of surgery the typical appearance of a late case of intestinal obstruction is described as follows: "The face is pale . . . the pulse rapid and feeble . . . the hands and feet, the tips of the nose and ears become cold. . . . He usually remains conscious to the end, and may fail to realize the gravity of his condition".² In the same book the following account is given of the terminal stages of acute peritonitis: "The face is pale and drawn, and assumes an anxious expression. The eyes are clear and bright, and mental faculties are often abnormally alert. . . . The face and extremities become cold and cyanosed . . . the pulse becomes small and running. . . . As a rule the patient remains conscious to the last, sometimes ceasing to complain, or even expressing himself as feeling better".³

The variation in the local conditions in the different diseases tends to mask the general resemblance; but if these local signs are excluded, the common features present a symptom-complex which is striking and peculiar when compared with almost any other acute toxæmia, such as that of

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streptococcal septicæmia, cellulitis, typhoid, diphtheria, pneumonia, or uræmia. Both in acute intestinal obstruction and acute peritonitis the patient is suffering from an acute toxæmia, and the clinical resemblance in the two diseases suggests the probability that the toxæmia originates in the same way in each.

In acute intestinal obstruction dehydration and a loss of salts by vomiting occur, but cannot be considered adequate cause for the toxæmia. The only remaining obvious source of toxin is the contents of the obstructed intestine. The toxicity of the intestinal contents has long been recognized by surgeons, as witnessed by the importance which is attached to obtaining immediate drainage of the obstructed bowel, rather than dealing with the cause of the obstruction, as a primary object of operation.

In acute peritonitis the type of toxæmia under discussion appears only in the later stages, in association with paralytic obstruction of the intestine. Here, again, the importance of obtaining drainage of the paralysed gut is widely, though not generally, recognized. Many procedures have been advocated with this object. The difficulties of draining bowel which has lost the power of contraction are, however, very great, and no method as yet devised is entirely satisfactory. This problem will be referred to again later.

The foregoing considerations suggested to me the possibility that the peculiar toxæmia described might result from the abnormal proliferation in the obstructed intestine of anaerobic organisms.

THE NORMAL DISTRIBUTION OF ANAEROBES IN THE INTESTINAL TRACT.

It is first necessary to consider the normal distribution of anaerobes in the intestine. Many anaerobes have been found in the human intestine. *B. sporogenes*, *B. welchii*, *B. tetani*, *B. histolyticus*, and many others have been isolated. Whether they are present as a natural flora or as passengers in the food is immaterial to the problem under discussion. Of those organisms which are known to produce toxins, *B. welchii* is by far the most abundant and most constant. It is an organism which requires for its growth and the production of toxin an anaerobic medium, which should be neutral or slightly alkaline. In acid medium the toxin is destroyed,⁴ and *B. welchii* would be rapidly outgrown by other organisms. Herter⁵ has shown that in the greater part of the small intestine the conditions are anaerobic, and the medium is alkaline, while in the large intestine the medium becomes acid, and in spite of the immense proliferation of organisms of all sorts in this portion of the gut, *B. welchii* is frequently absent from cultures of normal fæces.⁶ More recently Dudgeon⁷ found *B. welchii* present in only 35 per cent of 200 specimens of fæces from human cases.

The lower part of the small intestine thus appears to be the only part of the bowel suitable for proliferation of *B. welchii* and the formation of toxin. The passage of material through the small intestine is, however, extremely rapid. Normally, a barium meal passes through to the cæcum in three to four hours, and it is extremely rare to see any prolonged delay in the small intestine. During this period the reaction changes from acid to strongly

alkaline, back to neutral or slightly acid in the terminal ileum, so for only a fraction of that time is the reaction suitable. When the small bowel becomes obstructed or paralysed, however, ideal conditions exist for the proliferation of *B. welchii* and the formation of toxin.

In pyloric obstruction the acid reaction in the stomach and aerobic conditions would prevent proliferation and destroy toxin, and clinically pyloric obstruction gives rise to no acute toxæmia. Similarly in obstruction of the large intestine: so long as stagnation is confined to the large intestine, apart from possible differences of absorption, the acid reaction of the contents would destroy *B. welchii* toxin. Clinically it is a matter of common observation that constipation or intestinal obstruction gives rise to no acute toxæmia until the stagnation extends back into the small bowel, either by incompetence of the ileocaecal valve, or by increased difficulty of emptying the small intestine against increased pressure. It is therefore suggested that it is the extension of stagnation into the small intestine which marks the transition of chronic to acute intestinal obstruction in cases where the organic obstruction is situated in the large bowel. Broadly speaking, organic obstruction arising primarily in the small bowel is acute from the onset; that arising primarily in the large bowel may be chronic at first.

On this hypothesis there should therefore be a great proliferation of *B. welchii* in the small intestine of patients suffering from acute obstruction. In the later stages of the disease these organisms would be found in increased numbers higher up the intestines, and eventually in the vomit, though in the stomach proliferation would be checked actually by the acid reaction, and toxin destroyed. These considerations led me first to examine the vomit and the contents of the small intestine, in cases of acute obstruction and of peritonitis, for evidence of proliferation of *B. welchii*.

EVIDENCE OF THE PROLIFERATION OF *B. WELCHII* IN THE OBSTRUCTED OR PARALYSED SMALL INTESTINE.

Methods of Examination of Vomit and Small Intestine Contents.—As soon as possible after the material was obtained, films were made on an area of 1 square inch of slide, using one standard platinum loop of 2-mm. diameter. These films were stained by Gram's method, and give a rough idea of the relative numbers of organisms present.

Aerobic cultures were made by diluting one standard loopful of material in 2 c.c. of normal saline, and spreading one standard loopful of the diluted material on an agar plate of 3 in. diameter.

Anaerobic cultures were made by inoculating one standard loopful of material into tubes of Robertson's meat medium and milk, which had been previously heated for half an hour in boiling water. These were placed in a vacuum jar, which was exhausted to a negative pressure of 30 in. of mercury with a water-pump, and washed out with hydrogen at least three times. This method gave satisfactory anaerobic conditions, and surface colonies could be readily grown on solid media.

The identification of *B. welchii* depended upon: (1) The presence of organisms morphologically resembling *B. welchii* in the stained films and in

meat medium cultures; (2) The formation of storm-clot in milk: (3) The results of mouse inoculation, using pure antisera for *B. welchii*, *B. edematiens*, and *Vibrio septique* as controls.

Nearly all the specimens were, of course, heavily infected with other organisms. Amongst the aerobes, streptococci and coliforms were the most abundant, while amongst the anaerobes, *B. sporogenes* was usually present, but not apparently abundant in early cultures. Once mouse inoculation suggested the presence of *Vibrio septique*, but I failed to isolate it from the other organisms, and it apparently died out on sub-culture.

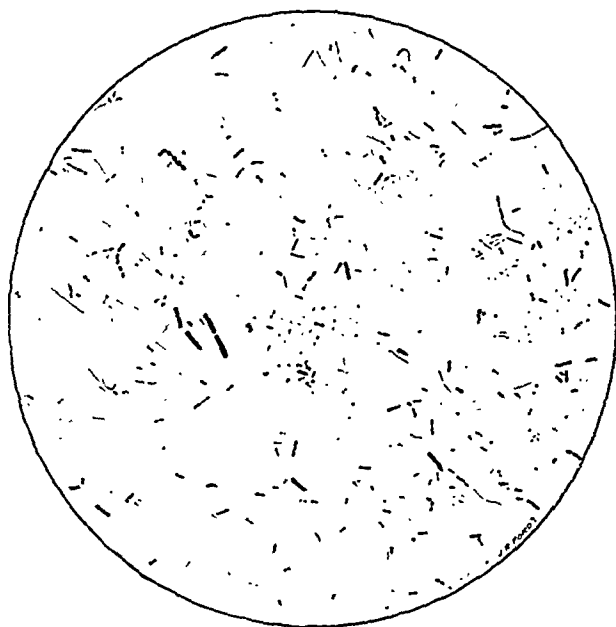


FIG. 179.—Standard film of vomit from a case of peritonitis.

Examination of Vomit.

—In vomit obtained from cases of acute obstruction, *B. welchii* was found in 11 out of 12 specimens. In vomit obtained from advanced cases of peritonitis, *B. welchii* was found in 19 out of 20 specimens. Some of the films prepared from fresh vomit showed large numbers of organisms indistinguishable from *B. welchii* (Figs. 179, 180), while in others these organisms were comparatively few. The numbers present in the original films did not, however, bear any constant relation to the severity of the case. This disparity may have been due to dilution of the intestinal material in the stomach, either by secretion

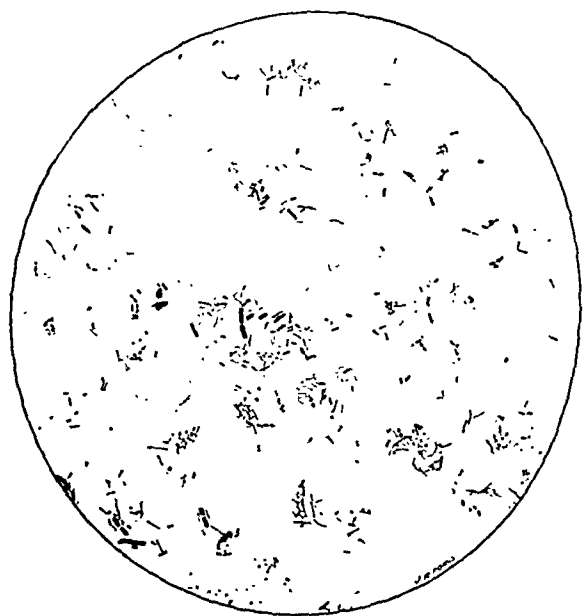


FIG. 180.—Standard film of vomit from a case of obstruction.

due to dilution of the intestinal material in the stomach, either by secretion

or by fluid taken by mouth. The vomit was usually obtained immediately after admission, before operation. As a control, vomit was examined from two cases of pyloric obstruction, one simple and one malignant, and from three cases in which there was no intestinal obstruction. In none of these was any evidence found of the presence of *B. welchii*.

Twelve test meals performed for various conditions were also examined, and in none were any organisms found resembling *B. welchii* on the stained films; in one test meal a positive result was obtained on culture.

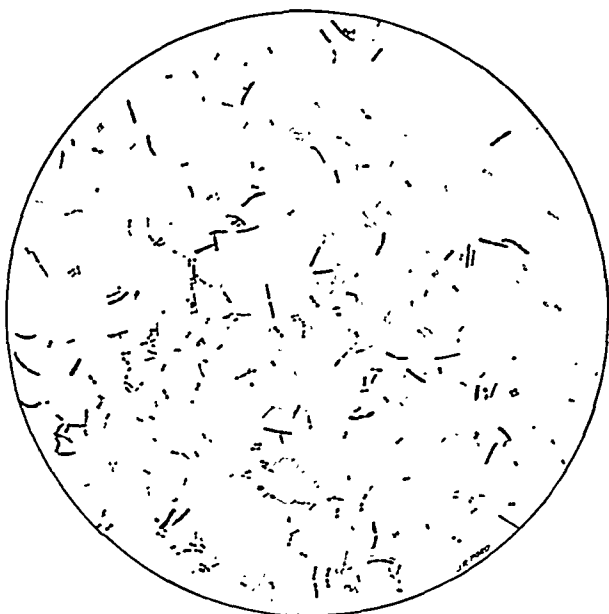


FIG. 181.—Standard film of small-intestine contents from a case of peritonitis.

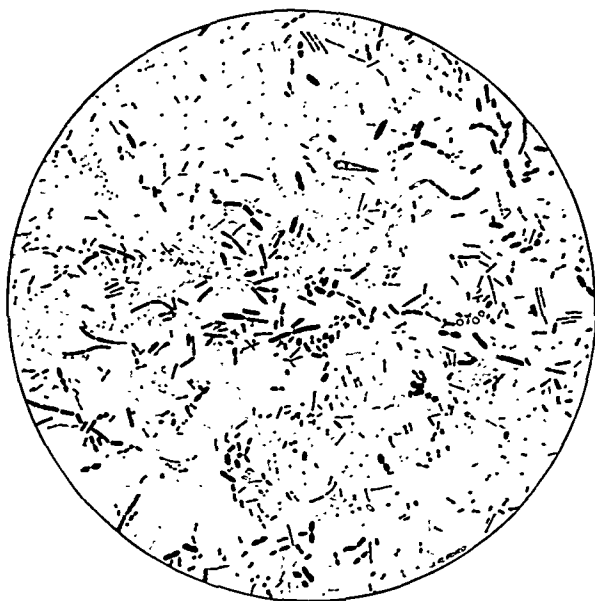


FIG. 182.—Standard film of small-intestine contents from a case of obstruction.

Examination of Small Intestine Contents.—The contents of the small intestine obtained post mortem from four cases of peritonitis, and one of acute obstruction, all showed large numbers of *B. welchii*.

Six specimens of small-intestine contents were obtained during life from human cases of intestinal obstruction and peritonitis. Four were cases in which jejunostomy had been performed, one for volvulus, one for obstruction by bands, two for peritonitis; the fifth was a case in which 2 feet of small intestine were resected for volvulus, and the sixth a duodenal fistula and

intestine were resected for volvulus, and the sixth a duodenal fistula and

peritonitis from acute cholecystitis. In all of these specimens enormous numbers of *B. welchii* were present (Figs. 181, 182). *B. welchii* was equally abundant in the small intestines of dogs in which acute obstruction and peritonitis had been produced in an experiment which will be described later.

As a control I was only able to obtain intestinal contents from one human case, killed in a street accident. Food was last taken four hours before death, and the material examined six hours after death. Very few organisms could be found in the stained film preparations of the upper part of the small intestine, but *B. welchii* was cultivated from the middle and lower part of the jejunum. In the lower ileum (Fig. 183) a fair number of *B. welchii* were seen, though the numbers were very small when compared with those present in

the cases of intestinal obstruction and peritonitis. This corresponds with the results obtained in human beings by A. Goldman,⁸ and with observations made on the intestinal flora of normal dogs by Torrey,⁹ and confirmed in four normal dogs by myself.

CONCLUSIONS AS TO PROLIFERATION OF *B. WELCHII* IN THE OBSTRUCTED OR PARALYSED SMALL INTESTINE.—*B. welchii* is present in enormously increased numbers in the small intestine contents and in vomited intestinal contents in cases where there is obstruction, whether organic or para-

lytic. There is at the same time an immense increase in other bacteria, but *B. welchii* is the only organism known to produce a powerful exotoxin. The morphological appearances of *B. welchii* are variable in the extreme, and I do not think it possible to enumerate individual anaerobic organisms with any degree of certainty on stained films. In consequence of this, no attempt was made to count the relative numbers in the original films.

It is, of course, improbable that great proliferation of *B. welchii* would take place under the conditions in the small intestine without formation of toxin; but one knows that with *in vitro* cultures toxin is not always easy to demonstrate in spite of active growth, and apart from its toxin *B. welchii* is a very innocuous organism. It is essential therefore that some evidence should be found for the presence of toxin in the contents of the obstructed intestine.

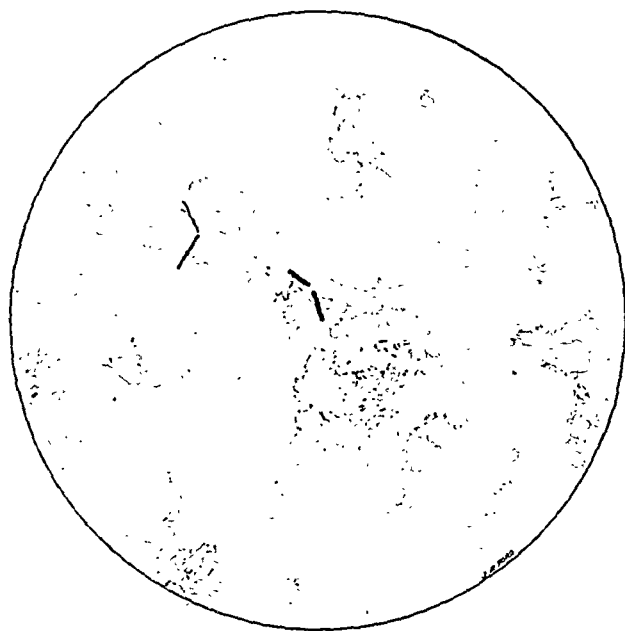


FIG. 183.—Standard film of contents of normal terminal ileum. A selected field showing organisms resembling *B. welchii*.

EVIDENCE OF THE PRESENCE OF *B. WELCHII* TOXIN IN THE CONTENTS OF OBSTRUCTED OR PARALYSED INTESTINE.

Attempts were made to demonstrate the presence of *B. welchii* toxin in the vomit and contents of the small intestine of advanced human cases, and, in view of the small number of human cases available, experimentally in dogs.

Methods.—The presence of *B. welchii* toxin in fluids can be demonstrated only by animal inoculation. The effects of the bacteria-free fluid mixed with normal horse-serum are compared with the effects of bacteria-free fluid mixed with *B. welchii* antitoxic serum. The recognized tests are: (1) Lethal effects in mice and guinea-pigs; (2) Intradermic reactions in guinea-pigs; (3) Lethal effects, or microscopical changes produced in the pectoral muscles, in pigeons. The presence of bile, irritant substances, and wide variations in reaction render the last two methods unsuitable for intestinal or vomited material, as I found that controls frequently exhibited doubtful changes. Consequently the first method only was used. Mice were selected, in order that, with a limited amount of material, the number of animals used might be as large as possible.

The difficulties of demonstrating the presence of toxin in vomit or intestinal contents are, however, very great. The toxin is extremely labile, and is rapidly destroyed by heat, or by slight variation in acidity.⁴ Even at laboratory temperature, toxin prepared *in vitro* may disappear in a few hours, if the reaction is unsuitable. The toxin is non-dialysable, and a considerable proportion is lost, even by rapid passage through bacteriological filters, so that sterilization is best effected by rapid centrifugalization. This method, however, proved to be unreliable with the centrifuge available, when applied to vomit or intestinal contents, on account of the presence of large amounts of mucus. In order therefore to obtain a bacteria-free inoculum, the material had to be passed through a Berkefeld candle (N. & V.), although it was known that a large proportion of any toxin present would be lost by this method. Filtration was extremely slow, even with preliminary centrifugalization, and as a rule occupied twenty-four hours. Filtrations were conducted in an atmosphere of hydrogen in the cold, in the hope of checking destruction of toxins.

Wide variations were found in reaction in different specimens; in the case of vomit the reaction was nearly always strongly acid, and accordingly unsuitable for intravenous inoculation. For the sake of uniformity, therefore, intramuscular inoculation was always used, though I believe that it usually requires more toxin and takes longer to obtain lethal results.

Examination of Vomit.—It will be seen from the foregoing reasons that it would be very improbable that any toxin could be demonstrated in vomit, and, in fact, of seven specimens of vomit tested in this way, all from extreme cases of peritonitis or acute obstruction, only from one were lethal effects obtained in mice. This vomit was from a case of general peritonitis in the terminal stages, and was neutral in reaction. Two mice which had received 0.75 c.c. of vomit filtrate in 0.25 c.c. normal horse-serum died within five days of inoculation. Two mice which had received protective *B. welchii* antitoxic serum and vomit filtrate in similar amounts were unaffected.

Examination of Intestinal Contents.—I have found great difficulty in obtaining material from the small intestine of human cases of acute obstruction or of peritonitis. Material obtained post mortem would be open to the obvious criticism that toxins might be formed after death.

Jejunostomy and ileostomy are not frequently performed on these cases at St. Thomas's Hospital, and during the last three years I have only obtained material from four cases, and only in two was there sufficient material for filtration. One was a case of small-bowel obstruction by bands, and one a case of peritonitis due to appendicitis. The technique adopted was the same as is described below in the examination of the intestinal contents of dogs, and the results of mouse inoculation are represented in *Table I*.

In view of the difficulty of obtaining adequate human material, it was decided to examine the small-bowel contents of dogs in which acute obstruction or peritonitis was produced experimentally. In three dogs peritonitis was produced as follows: The abdomen was opened under anaesthesia, the base of the appendix was ligatured so as to strangulate its blood-supply, and the abdomen closed. Later, on the appearance of definite abdominal distention, the animal was again anaesthetized, and, with continuous subcutaneous saline infusion, was kept alive as long as possible under anaesthesia, while the thoracic duct was drained in the neck in connection with an experiment which will be mentioned later (*see p. 306*). In two dogs acute obstruction was produced by ligaturing the ileum 3 in. above the ileocaecal valve, without interfering with the blood-supply. The remainder of the experiment was carried out as has been described above. Blood cultures were made at intervals during the later stages in connection with experiments mentioned on p. 306.

Immediately after the death of the animal the contents of the stomach and small intestine were examined. Stained films and cultures were made according to the technique already described. In each case enormous numbers of *B. welchii* were present in the contents of the small intestine. A similar flora, but in much smaller numbers, was found in the contents of the stomach. The smaller number of organisms in the contents of the stomach can only have been produced by dilution of the intestinal material by secretion.

The contents of the small intestine were then mixed with an equal volume of ice-cold normal saline, and were passed through a Berkefeld candle in an atmosphere of hydrogen in the ice-chest. Filtration was always slow and difficult, and took eighteen to twenty-four hours, even after dilution with saline. Cultural controls for sterility were put up, and mouse inoculation was then carried out.

Protected mice received 0.75 c.c. of filtrate and 0.25 c.c. of *B. welchii* anti-toxic serum intramuscularly. Unprotected mice received 0.75 c.c. of filtrate and 0.25 c.c. of normal horse-serum. The mice were kept under observation for six days after inoculation, and those which died were examined for the possibility of infection with *B. welchii*, as opposed to toxæmia, by heart-blood culture, as soon after death as possible. All these cultures were negative as regards *B. welchii*, though occasionally streptococci and coliforms were found. The results of these inoculations are represented in the following table:—

TOXAEMIA OF INTESTINAL OBSTRUCTION 303

Table I.—RESULTS OF INOCULATION OF INTESTINAL CONTENTS IN MICE, INDICATING THE PRESENCE OF *B. WELCHII* TOXIN.

SOURCE OF INTESTINAL CONTENTS	DURATION OF CONTINCTION	UNPROTECTED MICE		PROTECTED MICE	
		Total	Died	Total	Died
Human case, peritonitis ..	7 days	10	5	5	0
Dog, peritonitis, 1 ..	83 hours	4	4	2	0
" " 2 ..	65 hours	6	6	2	0
" " 3 ..	78 hours	6	4	4	0
Human case, obstruction ..	3 days	12	2	6	0
Dog, obstruction, 1 ..	56 hours	8	7	4	0
" " 2 ..	51 hours	8	0	4	0
Total mice used ..	..	54	28	27	0

The total number of mice used is, of course, small, and was limited by the difficulty of getting a larger amount of material through the filters in reasonable time. For the same reason the number of control mice was reduced. The material obtained from the second dog in the acute obstruction experiment was particularly troublesome in filtration, which may explain the entirely negative result obtained on this occasion.

The number of experiments is also small, but the procedure is a severe one, and I did not feel justified in further repetitions. The difficulties of working with *B. welchii* toxin at any time, and the special difficulties encountered in material which is full of mucus and of varying reactions, justify the deduction that a considerable concentration of *B. welchii* toxin is present in the small intestine in cases of peritonitis and obstruction.

As a control, the contents of normal human ileum, obtained six hours after death, the last meal having been taken four hours before death, were examined by the same method. This filtrate produced no ill effects in mice, which agrees with the findings of Davis and Stone.¹⁰

In view of the absence of clinical toxæmia in obstruction confined to the large intestine, there should be no toxin in the contents of obstructed large intestine. Material was obtained from three patients suffering from obstruction due to malignant disease, on whom colostomy was performed, and the filtrate inoculated into mice. Filtration was much more rapid than in the case of small intestine contents, and no dilution with saline was necessary. Large quantities also were available. With the three specimens, 16, 25, and 25 unprotected mice were inoculated. No serious ill effects were observed and there were no deaths. There was, therefore, no toxic substance found in the contents of the large intestine, even in the presence of obstruction, though stained film preparations of the same material showed large numbers of *B. welchii*.

CONCLUSIONS AS TO PRESENCE OF TOXIN OF *B. WELCHII* IN THE OBSTRUCTED OR PARALYSED INTESTINE.—(1) In one human case of peritonitis there was questionable evidence of the presence of *B. welchii* toxin in the vomit. (2) In one human case of peritonitis and one of acute obstruction

there was evidence of the presence of *B. welchii* toxin in the contents of the obstructed small intestine. (3) In the small-intestinal contents of 5 dogs in which obstruction or peritonitis had been produced experimentally, the presence of *B. welchii* toxin was demonstrated. Of 32 inoculated mice, lethal effects were obtained in 21, and 16 control mice that were protected with *B. welchii* antitoxin were unaffected. (4) *B. welchii* toxin was the only toxin found which was lethal to mice. (5) Contents of normal human ileum were found to be non-toxic in one case. (6) Contents of obstructed large intestine were found to be non-toxic in 3 human cases.

EVIDENCE OF ABSORPTION OF *B. WELCHII* TOXIN FROM OBSTRUCTED OR PARALYSED INTESTINE.

It only remains to be shown that *B. welchii* toxin is absorbed from the intestine and is responsible for the toxæmia. That cases suffering from acute intestinal obstruction and from peritonitis show clinically a toxæmia, and that the toxæmia bears a striking resemblance to that resulting from gas gangrene infections, may be taken as evidence of absorption. Peculiar though the

toxæmia is in many respects, still it is possible that the clinical features might be produced in other ways.

One of the most marked properties of *B. welchii* toxin is its hæmolytic power, and cases of acute obstruction and of peritonitis were examined for evidence of hæmolysis. The success of the clinical trial to be described later rather interfered with this part of the investigation. Anæmia and slight general icterus are well-known clinical features of severe cases which survive for some time, but I have only recently

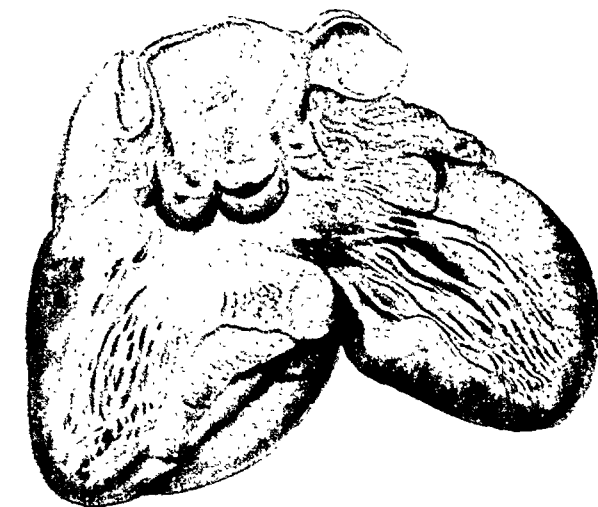


FIG. 184.—Heart showing hæmolytic staining. From a case of pneumococcal peritonitis.

begun to perform definite blood examinations. Hæmolytic staining of the intima of the great vessels and heart is a well-known post-mortem finding in cases of peritonitis, and was frequently found. Hæmolytic staining post mortem in cases of acute obstruction also is not infrequent. I have found it present in seven out of eleven cases, and in some the staining was very marked. It is easy, and I believe usual, to postulate the presence of a hæmolytic streptococcus in these cases, though there is no other clinical or post-mortem evidence of its presence. Had a streptococcal septicæmia been responsible for the condition, one would have expected other manifestations, such as changes in the spleen, and metastatic foci. These were certainly not present in the cases referred to above. Fig. 184

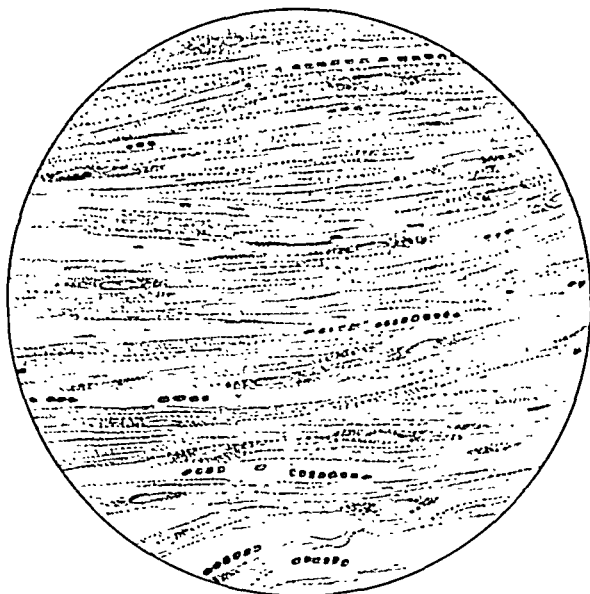


FIG. 185.—Cardiac muscle from fatal case of small-bowel obstruction, showing fine fatty degeneration.

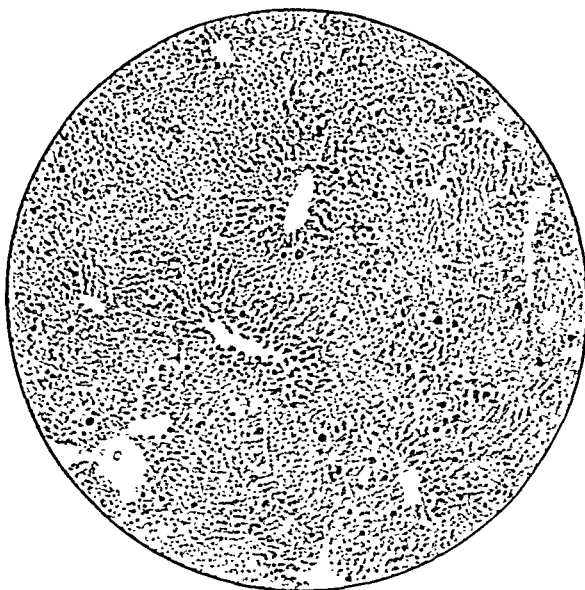


FIG. 186.—Liver from fatal case of small-bowel obstruction, showing fine fatty infiltration.

shows the heart from a fatal case of pneumococcal peritonitis in a girl 3 years old. The brilliant hæmolytic staining of the lining of the heart and great vessels seen here could not have been produced by the pneumococcus, which, though it forms methæmoglobin from blood *in vitro*, is not in the ordinary sense hæmolytic. This staining, however, may well have resulted from the absorption of *B. welchii* toxin from the stagnant contents of the paralysed small intestine, which was greatly distended. In the experiment already described, of the five dogs in which obstruction or peritonitis had been produced experimentally, four showed marked hæmolytic staining. Blood cultures were made in all of them within a few hours of death, and in only one was a positive result obtained; streptococci, coliforms, and *B. welchii* were grown.

Histologically, no very definite generalized changes are associated with *B. welchii* toxæmia. Kettle¹¹ in cases of gas gangrene found fatty degeneration in the liver, of no particular distribution, and in the heart muscle. Stone and Bernheim¹² found fine fatty degeneration in the liver of dogs with intestinal obstruction; and in the heart muscle and liver of eight human cases of peritonitis or obstruction, I have found similar changes in varying degrees (Figs. 185, 186). The changes recorded above are all compatible with, though not diagnostic of, a *B. welchii* toxæmia.

In view of the claims put forward recently by Costain¹³ and Edwards,¹⁴ that the mortality of peritonitis could be materially diminished by drainage of the thoracic duct in the neck, an attempt was made to examine the lymph obtained from dogs, in which peritonitis or obstruction had been produced experimentally, for the presence of *B. welchii* toxin. The finding of *B. welchii* toxin in the lymph of the thoracic duct would be absolute proof both of the formation and of the absorption of toxin. The results of this experiment were, however, entirely negative. This negative result must not be regarded as damaging to the hypothesis in any way. Substances of relatively small molecular dimensions, like bacterial toxins, are probably more rapidly absorbed by the blood-stream than by the lymph, as has been shown by Bolton¹⁵ and others. Further, *B. welchii* toxin, though present, might not be demonstrable on account of dilution in the lymph. Mr. J. H. Mason, of the Wellcome Research Institute, assisted with this experiment, which will be reported more fully elsewhere.

CONCLUSIONS AS TO ABSORPTION OF *B. WELCHII* TOXIN FROM OBSTRUCTED OR PARALYSED INTESTINE.—(1) The clinical features of late cases of acute intestinal obstruction and of peritonitis are compatible with the absorption of *B. welchii* toxin. (2) Evidence of intravascular hæmolysis as shown by staining of the endothelium of the heart and great vessels, in the absence of evidence of infection with other known hæmolytic organisms, is strong corroboration of the absorption of *B. welchii* toxin. (3) Fine fatty degeneration in the heart and liver of patients dying of acute obstruction and of peritonitis is compatible with the absorption of *B. welchii* toxin.

THERAPEUTIC TEST OF THE HYPOTHESIS.

The final test of the hypothesis was the administration of *B. welchii* anti-toxic serum in suitable cases of peritonitis and obstruction. If the hypothesis is correct, it should be possible, with the high titre antitoxic sera prepared by

Burroughs, Wellcome & Co., to combat the toxæmia and reduce the mortality of these diseases. As a method of proof, a therapeutic test is always the least reliable of criteria, as the number of cases must inevitably be too small to eliminate the possibility of chance success or failure. In medicine, however, the therapeutic test must finally be the most important.

Anti-gas-gangrene serum has, I find, been used therapeutically in France for some time in cases of 'gangrenous appendicitis'. The results of this treatment were summarized by D. G. Michel¹⁶ in 1923, and appeared to indicate a considerable reduction of mortality. The serum used by the French authorities is a polyvalent serum containing antibodies for a variety of anaerobic organisms, but with a considerable proportion of *B. welchii* antitoxin. The theoretical basis of its use depended upon the finding of *B. welchii* in a large proportion of acutely inflamed appendices by Veillon and Zuber,¹⁷ and more recently by Weinberg.¹⁸ Many observers, however, agree that *B. welchii* is only found, in the vast majority of cases, in the immediate vicinity of the perforated appendix, as a contamination by bowel contents, rather than as the cause of appendicitis or peritonitis. On stained film preparations of peritoneal pus from cases of acute appendicitis a few organisms that resemble *B. welchii* may frequently be seen, and I have often obtained them on culture. Their numbers are, however, quite insufficient to account for the profound toxæmia even when there is a considerable area of peritonitis. Further, in cases of pneumococcal peritonitis, in so-called 'primary peritonitis', and in many severe cases of peritonitis arising from acute appendicitis, when there is no macroscopic perforation of the appendix, *B. welchii* is entirely absent from the peritoneal infection. Yet in all cases which develop 'ileus', whatever the cause of the peritonitis, the clinical picture is the same in the late stages, and this is the clinical picture of an acute anaerobic toxæmia. Obviously the accidental presence of a few *B. welchii* in the peritoneum, as a result of intestinal contamination, cannot, in the majority of cases, account for the toxæmia, though when present it may be a contributory source of toxin. Anaerobic infections of the peritoneal cavity may occur occasionally, but were practically unknown during the late war, though the attention of many observers was concentrated upon the anaerobic organisms. It may be that the impossibility of accepting *B. welchii* as the causative organism of appendicitis and peritonitis accounts for the fact that the administration of 'anti-gas-gangrene' serum, as advised by the French surgeons, has not attracted more attention in this country. In view, however, of the high proportion of *B. welchii* antitoxin contained in the French anti-gas-gangrene serum, the success of its therapeutic employment in cases of appendicitis reported by Michel¹⁶ may be cited in support of the hypothesis put forward in this paper, that the toxæmia in late cases of peritonitis is due to the absorption of *B. welchii* toxin from the stagnant contents of the small bowel.

THERAPEUTIC TEST OF ANTI-GAS-GANGRENE SERUM IN CASES OF PERITONITIS.

At first it was decided to use cases of acute appendicitis for the clinical trial, because: (1) A fairly large number of cases are available at St. Thomas's Hospital annually; (2) Cases which are 'going wrong' give fair clinical warning,

which can be easily recognized, and definite signs of intestinal paralysis develop in nearly all fatal cases; (3) The mortality is well established, and fairly constant between 5 and 10 per cent. At St. Thomas's Hospital for the five years 1919-23 the average mortality was 6.5 per cent in 1418 cases.¹⁹ The mortality of a disease depends to a large extent upon local conditions, the habits of the population, practitioners and surgeons, and the transport and the hospital facilities available. The figures for St. Thomas's Hospital only are therefore used for comparison.

In a condition like acute appendicitis the total figures include a large majority of cases which never develop serious intestinal paralysis, in which the mortality is correspondingly low. It is, however, only by taking the total figures that individual differences of opinion can be avoided as to what constitutes local, spreading, or 'general' peritonitis.

It was decided to administer serum to all cases in which clinically one would say that the chances of survival were 50 per cent or worse. This included: (1) Moribund cases of severe general peritonitis; (2) Streptococcal peritonitis, unlocalized, in children under 12 years; (3) Cases which, after appendicectomy, continued to show signs of advance of the disease, by rising pulse-rate, abdominal distention, and toxæmia. In order to increase the number of cases, Mr. P. H. Mitchiner, Assistant Surgeon, St. Thomas's Hospital; Mr. A. C. Halliwell, Resident Assistant Surgeon; and Mr. C. V. Patrick, Surgical Registrar, consented to co-operate with me in the administration of *B. welchii* antitoxin to suitable cases. The series consisted of 256 consecutive unselected cases, which were distributed as follows:—

ANALYSIS OF CASES USED IN THE THERAPEUTIC TEST.

SURGEON	PERIOD	TOTAL CASES	DEATHS
A. C. H. ..	June 1, 1925, to June 1, 1926	91	2
B. W. W. ..	July 1, 1924, to June 1, 1926	82	0
C. V. P. ..	July 1, 1925, to June 1, 1926	34	1
P. H. M. ..	July 1, 1925, to June 1, 1926	21	0
Cases not operated upon during acute stage		28	0

Of the total 256 cases, 18 of the most severe were treated with *B. welchii* antitoxin, and of these, 10 were children under 12 years of age. Further details of the cases treated are given in *Table II*. There were 3 deaths, giving a mortality of 1.17 per cent. During the year 1925 a control series of 111 cases, consecutive and unselected, at St. Thomas's Hospital, under other surgeons who were not using *B. welchii* antitoxin, showed a mortality of 6.3 per cent.

Details of fatal cases.—

Case No. 35.—A woman, age 68, with thirty-two hours' history of symptoms. At operation the appendix was found to have perforated. There was some spreading peritonitis. Appendicectomy was performed and the abdomen closed. With the exception of some abdominal distention, progress was satisfactory until the nineteenth day after operation, when the patient was got up. No serum had been administered. After being got up, the patient became worse, and developed œdema of the legs and considerable abdominal distention. The bowels were kept open with

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Table II.—CASES OF APPENDICITIS IN WHICH B. WELCHII ANTITOXIN WAS ADMINISTERED.

NO. IN SERIES	AGE IN YEARS	DURATION OF DISEASE BEFORE OPERATION	OPERATION	WHEN ANTITOXIN FIRST ADMINISTERED	RESULT	REMARKS
22	5	72 hours	Appendicectomy	At operation	Recovery	Unlocalized streptococcal peritonitis
24	11	120 hours	Drainage	At operation	Recovery	'General peritonitis', appeared moribund
29	58	72 hours	Appendicectomy	At operation	Recovery	'General peritonitis', very ill
30	7	48 hours	Appendicectomy	At operation	Recovery	Unlocalized peritonitis, streptococcal type
32	11	72 to 96 hours	Appendicectomy	4th day after operation	Recovery	Progressive toxæmia after operation
33	5	72 hours	Appendicectomy	At operation	Recovery	Unlocalized peritonitis
35	68	32 hours	Appendicectomy	4 weeks after operation	Died 4½ weeks after operation	Cardiac failure (<i>see note, p. 308</i>)
37	3	48 hours	Appendicectomy	6th day after operation	Recovery	Progressive toxæmia, etc., after operation
44	43	56 hours	Appendicectomy	4 weeks after operation	Recovery	Intermittent obstruction during convalescence
47	39	48 hours	Appendicectomy	4th day after operation	Recovery	Progressive toxæmia, etc., four-month pregnancy aborted
48	4½	24 hours	Appendicectomy	3rd day after operation	Recovery	Progressive toxæmia and distention after operation
58	46	36 hours	Appendicectomy	4th day after operation	Died 6th day after operation	Local streptococcal peritonitis (<i>see note, p. 310</i>)
60	29	42 hours	Appendicectomy	At operation	Recovery	Spreading peritonitis, severe toxæmia
61	10	48 hours	Appendicectomy	At operation	Recovery	Spreading peritonitis, severe toxæmia
62	8	72 hours	Appendicectomy	At operation	Recovery	Unlocalized peritonitis, streptococcal type
63	6½	64 hours	Appendicectomy	At operation	Recovery	Marked distention and toxæmia
71	50	56 hours	Appendicectomy	4th day after operation	Died 4th day after operation	(?) Pulmonary thrombosis (<i>see note, p. 310</i>)
72	51	24 hours	Appendicectomy	3rd day after operation	Recovery	Progressive distention and toxæmia after operation

Total cases treated, 18; died, 3: children under 12 years old, 10.

enemata, but the patient sank and died thirty-one days after operation. *B. welchii* antitoxin was administered during the terminal stages.

POST-MORTEM EXAMINATION.—There were no signs of peritonitis. There was slight general distention of the intestine, but no mechanical obstruction could be found. The heart was small, brown, and soft. Death was reported to be due to cardiac failure.

Case No. 58.—A healthy policeman, age 46, with thirty-six hours' history of symptoms. At operation a perforated appendix was found, with spreading peritonitis. Two doses of castor oil had been administered before admission to hospital. On the third day after operation the abdomen was distended, he was slightly jaundiced, very restless and ill, with a pulse of 110. Pituitary and enemata failed to relieve the condition. On the fourth day the pulse was 120, the jaundice more marked, and the general condition worse. Fifty c.c. of anti-gas-gangrene serum were given intramuscularly. On the fifth day he appeared much better, distention was less, jaundice disappearing, and the pulse had dropped to 100. During the afternoon, however, he became rapidly worse; distention and restlessness returned, and by 8 p.m. he was 'wandering'. A further 50 c.c. of anti-gas-gangrene serum was then administered. There was no improvement, and the patient died fourteen hours later.

POST-MORTEM EXAMINATION.—There was a very little pus about the right iliac fossa. The whole of the small intestine, except the last 6 in. of ileum, was grossly distended. There was very marked hæmolytic staining of the heart and great vessels, and slight jaundice of the sclerotics.

Case No. 71.—A woman, age 50, with fifty-six hours' history of symptoms. At operation a perforated appendix was found in an ill-defined pelvic mass, with some spreading peritonitis. Progress was satisfactory until three days after operation. No serum had been administered. On the third day the patient had an attack of cyanosis, pain in the chest, and cardiac failure. The abdomen became somewhat distended. There were two similar attacks during the next twenty-four hours, and after the third the patient became unconscious and died. *B. welchii* antitoxin was administered shortly before death. She vomited once after the first attack of pain, and coughed up blood-stained froth before death. The condition was suggestive of pulmonary thrombosis or so-called embolism. A post-mortem examination was refused.

In *Cases Nos. 35 and 71* the administration of anti-gas-gangrene serum could not have any direct influence on the cause of death. They cannot, however, be excluded, because they would be included in any general mortality figures. *Case No. 58* must be regarded as a failure. Serum treatment was not started as early as it might have been, and the patient was far gone before the second dose was administered; but several cases which appeared to be quite as severe have recovered.

Clinical Effects of the Administration of *B. Welchii* Antitoxin in Cases of Peritonitis.—The clinical effects of the administration of serum were often striking and immediate. As a rule restlessness was greatly diminished or abolished, patients lost the 'acute consciousness', slept easily, and required little morphia to keep them quiet. Cyanosis, when present, disappeared, and in one case a definite icteric tinge faded rapidly.

In all successful cases the pulse-rate began to fall soon after the administration of serum. In cases which showed very marked toxæmia fall of pulse-rate sometimes did not occur for a day or two. One of the most striking effects was the influence of administration of serum on abdominal distention. Sometimes in the less severe cases distention disappeared and the bowels acted spontaneously within a few hours. In more severe cases, though the

bowels as a rule began to act spontaneously, in spite of previous failure of enemata and pituitary injections. distention subsided more gradually, and often did not completely disappear until convalescence was well established.

With the exception of the use of anti-gas-gangrene serum, these cases were, as a whole, treated by the ordinary methods in vogue at St. Thomas's Hospital. Cases seen during the first forty-eight hours of the disease were treated by appendicectomy. Excluding young children, patients seen after more than forty-eight hours after the onset of the disease were not operated upon until the acute attack had subsided, unless there were signs of spreading peritonitis or of the development of an abscess. In young children appendicectomy was always carried out as soon as possible. Drainage, other than that of the abdominal wall, was employed only when there was a definite abscess cavity, and when there was doubt about the suture line, or when the presence of concretions in the abdomen was suspected. In my own cases I did not employ injections of pituitary in the after-treatment.

THERAPEUTIC TEST OF ANTI-GAS-GANGRENE SERUM IN CASES OF ACUTE OBSTRUCTION.

I can find no record of anti-gas-gangrene serum having been used in this condition before. Cases of acute intestinal obstruction were not at first used in the therapeutic test—first, on account of the relatively small numbers

Table III.—CASES OF ACUTE OBSTRUCTION TREATED OR NOT TREATED WITH B. WELCHII ANTITOXIN.

CAUSE OF OBSTRUCTION	CONTROL SERIES 1919-25 NOT TREATED WITH B. WELCHII ANTITOXIN		TEST SERIES 1924-26. TREATED WITH B. WELCHII ANTITOXIN WHEN NECESSARY	
	Total No.	Deaths	Total No.	Deaths
Malignant obstruction with acute symptoms ..	28	11	10	1
Adhesions or bands ..	24	4	10	1
Internal strangulation ..	23	9	2	1
Intussusception with tumour	3	2	2	0
Volvulus, small intestine ..	3	2	1	1
Volvulus, large intestine ..	1	1	2	0
Inguinal hernia ..	44	6	11	0
Femoral hernia ..	66	11	13	1
Umbilical hernia ..	22	7	3	0
Totals	214	53	54	5

Mortality in control series, 24·8 per cent ; mortality in test series, 9·3 per cent.

available annually ; secondly, because it is impossible to predict before operation how any given case will behave. Patients sometimes die very suddenly after operation for no apparent reason, and successful cases seldom cause anxiety after relief of the organic obstruction.

In a series of 54 cases, however, *B. welchii* antitoxin was administered for therapeutic reasons in 19. These were under the care of the same surgeons

Table IV.—CASES OF ACUTE OBSTRUCTION IN WHI

NO. IN SERIES	AGE IN YEARS	CAUSE OF OBSTRUCTION	DURATION BEFORE OPERATION	OPERATION
21	71	Strangulated umbilical hernia ..	72 hours	Division of bands, drainage of sac
27	51	Volvulus of cæcum	38 hours	Reduction, cæcostomy
36	15	Bands following appendicitis ..	20 hours	Division of bands ..
41	70	Carcinoma of rectum	120 hours	Colostomy
45	29	Volvulus of colon	56 hours	Colectomy, anastomosis, sigmoid ascending colon
51	60	Carcinoma of sigmoid colon	72 hours	Colostomy
52	56	Band	52 hours	Division of band
53	62	Strangulated femoral hernia	40 hours	Radical cure
56	46	Strangulated inguinal hernia	12 hours	Radical cure
57	23	Volvulus of small intestine	63 hours	Resection 2-ft. ileum, ileosigmoido-
59	43	Strangulated internal hernia	72 hours	Reduction
65	14	Bands following acute appendicitis ..	120 hours	Ileo-transverse anastomosis ..
66	38	Carcinoma of rectum	36 hours	Sigmoid colostomy ..
67	69	Strangulated femoral hernia	48 hours	Radical cure
68	58	Internal strangulation	168 hours	Reduction
70	42	Bands	96 hours	Division of bands, ileostomy
72	66	Strangulated femoral hernia	36 hours	Radical cure
73	55	Strangulated femoral hernia	120 hours	Resection of small intestine, radical
76	52	Carcinoma of splenic flexure	96 hours	Transverse colostomy ..

who took part in the therapeutic test of the use of *B. welchii* antitoxin in cases of acute appendicitis. The cases were unselected and consecutive, with the exception of two which are not included. These two, one of strangulated femoral hernia, one of internal strangulation in an intestinal hernia, appeared before operation to be perfectly fit, but, during the concluding stages of the operation for relief, became suddenly collapsed and died before serum could be administered. Both were healthy men, 53 and 51 years of age respectively.

The mortality of acute obstruction, like that of acute appendicitis, depends largely upon local conditions. It is, moreover, very difficult to eliminate

WELCHII ANTITOXIN WAS ADMINISTERED.

WHEN ANTITOXIN FIRST ADMINISTERED	RESULT	REMARKS
At operation	Recovery	Abscess in sac and perforation of gut
At operation	Recovery	Severe toxæmia
At operation	Recovery	Severe toxæmia
At operation	Recovery	Great distention
At operation	Recovery	Obstruction only, no strangulation
At operation	Recovery	Great distention and severe toxæmia
At operation	Death 6th day after operation	Streptococcal septicæmia (<i>see note, p. 314</i>)
At operation	Recovery	Severe toxæmia in feeble subject
At operation	Recovery	—
At operation	Death 5 hours after operation	Extreme toxæmia (<i>see note, p. 314</i>)
At operation	Recovery	Considerable small-bowel distention
hours after operation	Recovery	Progressive distention, not relieved by pituitary injections or enemata
At operation	Recovery	Severe toxæmia and distention
At operation	Recovery	Feeble subject
At operation	Death 24 hours after operation	Extreme toxæmia (<i>see note, p. 314</i>)
At operation	Recovery	Severe distention and toxæmia
At operation	Recovery	Moderate distention
4 hours after operation	Death 6 days after operation	Post-mortem: gangrene of gut (<i>see note, p. 315</i>)
At operation	Death 20 hours after operation	Severe distention and toxæmia in bad subject (<i>see note, p. 315</i>)

errors due to individual differences of opinion as to what constitutes intestinal obstruction in cases of external hernia, and this fact is important because of the large proportion of such cases. For comparison I have therefore taken figures from the paper to be published by Mr. C. M. Page²⁰ on the mortality at St. Thomas's Hospital for the five years 1919-23. In this series, and in my series of cases which were used for the therapeutic test of *B. welchii* antitoxin, the classification was done by Mr. C. V. Patrick. In *Table III* the two series are given side by side for comparison. Cases of obstruction due to malignant disease, though arising primarily in the large bowel, are included in the series only when there were acute symptoms, for the reasons suggested on p. 297.

Cases of idiopathic intussusception in infants are excluded, because in the vast majority manifestations of intestinal obstruction do not develop. Mesenteric thrombosis is also excluded, as the cause cannot be removed by operation.

The number of cases in the test series is very small, but it is given for what it is worth. With this reservation the mortality shows a striking improvement.

Details of the 19 cases to which anti-gas-gangrene serum was administered are given in *Table IV*. With the exception of the use of the serum the usual surgical treatment was carried out.

The clinical effects of the administration of serum in cases of acute obstruction were similar to those seen in cases of peritonitis. These clinical signs of improvement may, and commonly do, follow the simple surgical relief of the obstruction; it is consequently only by considering the series as a whole that the clinical effects can be assessed. The following are notes of the five fatal cases.

Details of Fatal Cases.—

Case No. 52.—A man, age 56, with old Pott's disease of the spine and great deformity. He had had an inguinal hernia for many years, and was admitted with a fifty-two hours' history of pain and vomiting coming after replacing the hernia. He was a poor surgical risk, and appeared very ill. Forty c.c. of *B. welchii* antitoxin and a pint of normal saline were given intravenously before operation. Laparotomy was performed, and the bowel found caught over a band at the internal orifice of the inguinal hernia. The gut was viable, and was returned to the abdomen. Twenty-four hours after operation the patient appeared to be in excellent condition, with the exception of some post-anæsthetic bronchitis. The bowels were opened twice naturally, and there was no distention. Forty-eight hours after operation he developed a streptococcal cellulitis at the site of the hypodermic injection into the arm, and died four days later. A pure culture of hæmolytic streptococcus was grown from the blood before death.

POST-MORTEM EXAMINATION.—The bowel was not distended; death was due to streptococcal septicæmia; there was no hæmolytic staining of the heart or great vessels.

Case No. 57.—A girl, age 23, with sixty-three hours' acute abdominal pain. On admission she appeared to be extremely ill, and an attempt was made to improve her condition with saline infusion and morphia for six hours before operation. Laparotomy was then performed, and the obstruction was found to be due to volvulus of the lower ileum over a band. A portion of gut about 2 ft. long was not viable, and was resected, an end-to-end anastomosis being performed. The distended small intestine above was also anastomosed to the transverse colon. The operation was difficult on account of intestinal distention. Intravenous saline and 60 c.c. of *B. welchii* antitoxin were administered during the operation. The patient was practically pulseless on leaving the table, and died a few hours afterwards without regaining consciousness. Post-mortem was refused.

Case No. 68.—A man, age 58, with seven days' history of acute abdominal pain and vomiting. On admission his condition was very bad indeed. At laparotomy the lower ileum was found strangulated by a band in the pelvis. The gut was very 'sodden', and perforated accidentally. The band was divided, ilco-transverse anastomosis was performed, and the abdomen closed. Sixty c.c. of *B. welchii* antitoxin were given intramuscularly on the table, and a further 60 c.c. sixteen hours later. The patient became delirious twenty-four hours after operation, and died. Abdominal distention was very marked.

POST-MORTEM EXAMINATION.—There was little peritonitis. The small intestine was grossly distended. The heart and aorta showed an intense hæmolytic staining.

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Case No. 73.—A man, age 55, with a five days' history of strangulation of a femoral hernia. At operation a loop of small gut was found to be gangrenous, and 4 in. were resected. After operation the patient did not improve, constipation was absolute, and distention became more marked. During the succeeding four days six injections of pituitary and repeated enemata failed to bring about any relief. *B. welchii* antitoxin was administered intramuscularly in doses of 40 c.c. daily, from the second day until the patient died on the sixth day after operation. No action of the bowels was obtained, and distention did not appreciably diminish. There was a general icteric tinge during the later stages.

POST-MORTEM EXAMINATION.—There was great distention of the small intestine, and about six inches of gut above the site of resection were gangrenous. There was some peritonitis in this area. The heart and great vessels showed slight hæmolytic staining.

Case No. 76.—A man, age 52, who had suffered from 'asthma, bronchitis, and a weak heart' for years. He had had chronic obstruction for 'some weeks', becoming acute for four days. On admission his condition was bad and distention very marked. At operation a carcinoma of the splenic flexure was found, and a transverse colostomy was performed. Sixty c.c. of *B. welchii* antitoxin were given on the table. He did not regain consciousness, and died twenty hours later. A post-mortem examination was refused.

The fatal issue in *Cases Nos. 52 and 73* cannot be regarded as evidence of failure of the antitoxin. Such cases, however, occur in any series and contribute to the general mortality.

CONCLUSIONS AS TO THE THERAPEUTIC VALUE OF *B. WELCHII* ANTITOXIN IN CASES OF INTESTINAL OBSTRUCTION AND PERITONITIS.

1. In cases of peritonitis with paralytic obstruction there was a marked clinical improvement as the result of administration of *B. welchii* antitoxin. In cases of organic obstruction similar effects were obtained, but in individual cases it was, as a rule, impossible to differentiate between the effects of the serum and the effect of successful operative relief of obstruction.

2. There is a great improvement in the mortality-rate in the test series of cases to which antitoxin was administered when necessary. In 256 cases of acute appendicitis the mortality was 1.17 per cent as opposed to the normal mortality of 6.3 per cent; in 54 cases of acute intestinal obstruction it was 9.3 per cent as opposed to the normal rate of 24.8 per cent.

3. The beneficial effect of *B. welchii* antitoxin is evidence of absorption of *B. welchii* toxin in cases of intestinal obstruction, whether organic or paralytic.

DOSAGE AND INDICATIONS FOR TREATMENT WITH *B. WELCHII* ANTITOXIN.

The therapeutic use of *B. welchii* antitoxin is in the experimental stage. The following notes are included for the use of those who wish to test its value.

It is not suggested that the use of this antitoxin is in any way alternative to the recognized primary surgical treatment of intestinal obstruction and of peritonitis by the relief of obstruction and the removal of the cause of peritonitis. It is advocated as a means of combating toxæmia of intestinal origin consequent upon stagnation of the contents of the small intestine, a toxæmia which cannot otherwise be dealt with successfully.

The administration of horse-serum antitoxin has, however, certain disadvantages: (1) It renders the patient sensitive, so that when serum may be necessary afterwards for some other condition, its administration may be more difficult. (2) It may produce rashes and other phenomena which are distressing, though not dangerous. (3) There is the remote risk of anaphylaxis. (4) It is expensive, and, to be of use, large amounts must be given.

The vast majority of cases of acute appendicitis will recover by treatment on the ordinary surgical lines. In cases which develop signs of intestinal obstruction, however, the mortality is very high, and the disadvantages of serum therapy are, by comparison, negligible. In cases of acute intestinal obstruction of the forms discussed, the mortality is normally high—between 20 and 30 per cent—and I suggest that serum should be used as a routine whenever there is evidence of small-bowel involvement. Further, it is not uncommon to see cases which appear to be quite fit before operation, but become rapidly worse after the relief of the obstruction, like the two cases already mentioned, so that it is impossible to predict how any given case will behave. This sudden and unexpected turn for the worse may be due to the liberation of the highly toxic contents of the obstructed intestine and the rapid absorption of a lethal dose of toxin. The only way to combat this eventuality would be the intravenous administration of an adequate dose of antitoxin before operation, if necessary intravenously, on the table.

The effect of antitoxic serum is to neutralize the toxin after its absorption from the intestine. Absorption of the toxin will continue until the small intestine is emptying normally. It is important therefore to recognize, particularly in paralytic obstruction due to peritonitis, that a clinical improvement is not an indication for stopping the administration of serum, which must be continued until the small bowel is emptying itself regularly and effectively.

In the therapeutic use of antisera it is essential that the dose should be adequate. The disadvantages of the administration of horse-serum are not increased with the size of the dose, except as regards cost. There is no maximum dose, but there are minimum doses, the administration of which is futile. The younger the patient the higher the mortality of peritonitis, and so the greater the necessity for an adequate dose of antitoxin. Further, anaerobic toxin can produce severe cardiac degeneration, and it is essential that the antitoxin should be administered before this has gone too far to be recoverable.

In cases of peritonitis patients are gravely ill, in part, according to the hypothesis, on account of the intestinal toxæmia, but also on account of their peritonitis. For the direct treatment of the latter, the use of anti-gas-gangrene serum contributes nothing, and inevitably cases must occur which die on account of the peritoneal suppuration, apart from intestinal toxæmia, though no such cases occurred in this series. It is well known, however, that the peritoneum has extraordinary powers of dealing with infection, and, if the intestinal toxæmia can be kept in check by the administration of *B. welchii* antitoxin, in the vast majority of cases, if given time, the patients will overcome their peritonitis.

The serum used was anti-gas-gangrene serum containing *B. welchii* and *Vibrio septique* antitoxins, series G 155, prepared by Messrs. Burroughs, Wellcome & Co. for therapeutic use. The serum is of higher titre than the

gas-gangrene serum used during the war, and has been found to be of value in treating cases of gas-gangrene resulting from street accidents. It is hoped that a more concentrated serum will shortly be available.

In consideration of the above, it is suggested that, in cases of peritonitis, *B. welchii* antitoxin should be administered to those patients who show evidence of intestinal paralysis and anaerobic toxæmia, as manifested either by severe or progressive abdominal distention, increasing pulse-rate, restlessness, or repeated vomiting, especially if offensive or brown, particularly if these signs appear after surgical treatment has been carried out. In extreme cases the administration of serum should be begun at the earliest possible moment—if practicable, before operation. The initial dose of serum to be given should be at least 80 c.c. intramuscularly, and in extreme cases an additional 40 c.c. intravenously. After the initial dose 40 to 80 c.c. should be given intramuscularly every day until the bowels are moving spontaneously and regularly and distention has almost or completely gone, and absorption of toxin consequently been brought to an end. The patient should be kept 'desensitized' against horse-serum until all risk is passed of the development of obstruction, which is apt to come on as the result of peritoneal matting during convalescence.

In cases of acute intestinal obstruction indications for the use of antitoxin are, broadly speaking, the same as those given in the previous paragraph in connection with cases of peritonitis, though the abdominal distention may be caused sometimes by the large bowel alone. The clinical appearances, however, of cases of acute intestinal obstruction are apt to be deceptive, in that, as already mentioned, cases showing no evidence of toxæmia before operation not infrequently die rapidly with toxæmic symptoms soon after successful operative relief. Therefore I would suggest that the only way of avoiding unexpected failures is by intravenous administration of 40 c.c. of antitoxin prophylactically before operation, preferably with saline solution if there is much dehydration, and an additional 40 c.c. of serum intramuscularly. Afterwards, as in cases of peritonitis, the administration of serum should be continued until normal evacuation of the bowel is re-established. I have myself at times used smaller doses than those here advocated, but the series was experimental, and patients were kept under constant personal observation. Latterly I have been convinced that the use of larger doses is the only way of securing full benefit of the serum.

RESULTS OF PREVIOUS INVESTIGATIONS OF THE TOXÆMIAS OF ACUTE INTESTINAL OBSTRUCTION.

A vast amount of research has been done on the toxæmia of acute intestinal obstruction, and the literature on the subject is correspondingly extensive. I will refer only to such work as I have been able to find which appears to bear on the aspect of the subject under discussion.

Murphy and Brooks,²¹ Dragstedt,²² and others have shown that the presence of bacteria in the obstructed intestine is necessary for the development of toxæmia. Stone and Bernheim¹² and Dragstedt²³ were able to obtain from the contents of obstructed intestine in dogs material which was toxic to

animals on intravenous injection. This toxic substance was extremely stable, withstood heating to 70° C. for one hour, and was not destroyed by filtration. Dragstedt was unable to demonstrate the development of any immunity in animals which had been subjected to repeated sublethal doses, and suggested that the poison was a product of bacterial fermentation of the histamine type and not a true bacterial toxin. No mention was made of the reaction of the material injected, which must be an important factor when relatively large amounts are introduced intravenously.

Using Berkefeld filtration for the sterilizing of intestinal contents and intramuscular injections, I have never found any evidence of the toxin described by these workers. It therefore seemed possible that the method of sterilizing the material for animal inoculation by heating to 70° C. might be responsible for the liberation of the toxic substance. With a view to testing this possibility the following experiments were carried out.

Intestinal contents obtained by jejunostomy from two human cases, one of obstruction due to bands, one of peritonitis, were divided into two portions. One portion was prepared as already described for examination for the presence of *B. welchii* toxin, by Berkefeld filtration in the cold; the other was heated at 70° C. for one hour before filtration, as described by the American workers. Each portion was then inoculated into two groups of mice, one group receiving in addition *B. welchii* antitoxin, the other group normal horse-serum, as in the tests for the presence of *B. welchii* toxin. The results are represented together in Table V.

Table V.—RESULTS OF TESTS FOR *B. WELCHII* TOXIN IN INTESTINAL CONTENTS IN MICE.

SOURCE OF MATERIAL	COLD FILTRATE OF INTESTINAL CONTENTS				HEATED FILTRATE OF INTESTINAL CONTENTS			
	Mice injected with filtrate and <i>B. welchii</i> anti- toxin		Mice injected with filtrate and normal horse- serum		Mice injected with filtrate and <i>B. welchii</i> anti- toxin		Mice injected with filtrate and normal horse- serum	
	Total	Died	Total	Died	Total	Died	Total	Died
Obstruction by bands	6	0	12	2	6	3	12	5
Peritonitis	5	0	10	5	6	3	8	4
Totals	11	0	22	7	12	6	20	9

It appears, therefore, that in these two cases a toxic substance was liberated from the intestinal contents by heating. This substance was not neutralized by *B. welchii* antitoxin, and was not present in the unheated material. Further investigation is being made on this point.

It is interesting to find that in 1904 Kamen is reported by Herter²⁴ as having obtained *in vitro* soluble thermostable poisons from *B. welchii* cultures. The effects of these poisons when inoculated into rabbits closely resembled the effects obtained on animal inoculation of the 'toxin' obtained from obstructed intestine by Stone, Bernheim, and Dragstedt. These poisons could not, of course, be the true exotoxin of *B. welchii*, which is rapidly destroyed by heat, and could not have survived the method of preparation employed by these workers.

DISCUSSION.

The investigation which is described in this paper was begun on the hypothesis that the toxæmia of acute intestinal obstruction, whether organic or paralytic, is, in part at least, due to the absorption of anaerobic toxins from the stagnant contents of the small intestine. It is not asserted that *B. welchii* is the only toxin, but it was the only one of which evidence was found during this investigation. It has not been possible to produce absolute proof of the hypothesis as a whole, but in each particular line of approach evidence has been found in support of the probable truth of the original assumption. Failures have been readily explicable by the limitations imposed by the nature of the materials under investigation and the difficulties of technique. Further, the hypothesis is in complete accordance with the known clinical features, and, if it is true, offers a simple solution for many hitherto unexplained problems.

The remarkable difference between patients suffering from absolute constipation even for weeks, with nothing more untoward than lassitude, a furred tongue, and a headache, and a patient with acute obstruction of the intestine, is explained by the fact that in the former there is no material stagnation above the ileocecal valve, and hence there is no formation of *B. welchii* toxin. Similarly, the complete absence of toxæmia in cases of pyloric obstruction, and the almost invariable and immediate benefit which results from operative relief, are explained by the fact that in the stomach the aerobic acid conditions prevent the formation of *B. welchii* toxin. Even in pyloric obstruction due to malignant disease, when as a rule hydrochloric acid is absent, the reaction is still usually acid. It is possible, in those rare cases in which the reaction becomes neutral, that the proliferation of *B. welchii* and the development of toxæmia might occur. A case of 'acute hæmorrhagic gastritis' which came under observation recently confirms this possibility.

The relatively high mortality of acute obstruction of the small intestine by bands and adhesions—a mortality which has not altered materially for many years—coincides with the presence of ideal conditions in the small intestine for the proliferation of *B. welchii* and the formation of this toxin. Further, the sudden unexpected deaths after most successful operative relief of small-bowel strangulation may be explicable on the hypothesis by the rapid absorption of a lethal dose of toxin from the contents of the obstructed loops after their release.

The most difficult feature of intestinal obstruction to overcome successfully is paralysis of the small intestine. In cases of organic obstruction paralysis persists often after removal of the organic cause. In peritonitis the obstruction may be entirely paralytic, though at times, in part at least, it may be organic. Many procedures have been advocated with a view to overcoming this paralysis, and emptying the obstructed bowel. Injections of pituitary and eserine, and drainage of the small bowel by ileostomy, jejunostomy, or ileocolostomy, have all been tried with varying success; and success or failure in any case probably depends upon whether the bowel is still able to contract or not. If the bowel has lost the power of contraction, pituitary is ineffective, and drainage will only empty the loop into which an opening

is made, and the results of drainage are frequently so disappointing in this respect that these methods have not received general acceptance. Of five cases in which ileostomy was performed for peritonitis or obstruction, sufficient intestinal contents for investigation for the presence of *B. welchii* toxin was obtained only twice, and to these two cases *B. welchii* antitoxin was being administered in large amounts. Now the toxin of *B. welchii* has a powerful effect upon muscle tissue, and this paralysis of the intestine may well be due in part to the presence of *B. welchii* toxin in the contents, to which the intestinal wall is exposed in its greatest concentration. The administration of antitoxin, besides combating the general toxæmia, may help to overcome the small-bowel paralysis. In the absence of organic obstruction, if the intestine is able to contract, absorption will cease on the evacuation of the toxic contents to the exterior, or into the large bowel, where the toxin is destroyed by the acid reaction.

It was observed repeatedly, during the clinical trial, that, after the administration of *B. welchii* antitoxin, distention rapidly diminished or disappeared, and the bowels were opened spontaneously. As these effects always coincided with clinical improvement, it is impossible to attribute them directly to the antitoxin with certainty, and further investigations are therefore being carried out.

The striking difference between the gravity of the clinical condition of the patient suffering from the presence of pus in the peritoneal cavity and that of a patient suffering from the presence of pus in another situation, such as the pleura, has long been the subject of speculation. The same difference is found when there is a localized collection of pus in the abdomen, where the area of contact with the small intestine is small, in contrast to when there is a diffuse peritoneal infection, where the area of contact with the small intestine is great. Peculiarities of absorption from the peritoneum have been postulated and rejected. More recently the importance of the intestinal stagnation which is associated with peritonitis has been emphasized by many writers, but the nature of the resultant toxæmia has not been investigated. This hypothesis offers some explanation for these differences, in that the degree of stagnation and consequent production of *B. welchii* toxin depends upon the extent of small intestine affected by inflammation.

The literature of intestinal intoxication is immense, but, so far as I am aware, experimental results have all been negative, with the exception of the work of the American investigators already discussed. I believe that the experiments described in this paper are the first to indicate the presence of a true toxin of intestinal origin, its nature, and the conditions necessary for its production. The hypothesis, if correct, opens a wide field for investigation. Therapeutically, if subsequent results are as encouraging as those reported in this paper, the application of the hypothesis is important, because of the large number and variety of cases in which stagnation may occur in the small intestine as the result of organic or paralytic obstruction. Such cases have at present a high mortality, which may be materially reduced by the use of antitoxin.

The only possible objection to the hypothesis that I have been able to find is the rarity in cases of obstruction or peritonitis of the occurrence of

generalized *B. welchii* infections, giving rise to metastatic lesions and the finding of 'foaming liver' post mortem. 'Foaming liver' is a phenomenon resulting from post-mortem changes in a body in which there has been a general dissemination of *B. welchii* before death. It is not a very frequent occurrence in laboratory experiments, and was not common in human cases of gas-gangrene infection during the late war. I have, however, seen 'foaming liver' in five human cases of puerperal infection with *B. welchii*, and in one case of typhoid fever. I have never seen a 'foaming liver' from a case of obstruction or peritonitis, and have only once seen a metastatic lesion arising in the 'pressure points' of the back in the case of appendicular peritonitis. Local post-operative infections of the abdominal wall with *B. welchii* are not so uncommon, but are by no means frequent. These local infections must result from direct faecal contamination of the wound, or contamination with faecal pus, which very frequently contains *B. welchii*; either of these must be a very common occurrence. I can only suggest that it requires very particular conditions for the establishment of *B. welchii* infection in living human tissues, the most important probably being an impairment of the blood-supply; and the rarity of the establishment of *B. welchii* infections of the abdominal wall lends support to this view. Further, the organism is almost ubiquitous, in dust, in soil, and milk; yet in civil practice gas-gangrene is extremely rare, even after street accidents, unless there has been great tissue damage. Growth in a hollow viscus, such as the intestine, outside the sphere of the influence of the living tissues, is an entirely different matter, which under suitable conditions has been shown in this paper to occur readily, and absorption of the soluble toxins may easily take place without any invasions of the tissues by the bacillus.

SUMMARY.

1. The hypothesis put forward in the paper is that the toxæmia in cases of intestinal obstruction, whether organic or secondary to peritonitis, results, in part at least, from the absorption of the toxin of *B. welchii*, due to the proliferation of this anaerobe in the stagnant contents of the small intestine.

2. The clinical resemblance of the toxæmia of intestinal obstruction and peritonitis to that of gas-gangrene is discussed.

3. Evidence is given of the proliferation of *B. welchii* in the small intestine in cases of intestinal obstruction and peritonitis in human subjects and in these diseases experimentally produced in dogs.

4. Evidence is given of the presence of *B. welchii* toxin in the small intestine in intestinal obstruction and peritonitis in human subjects and in these diseases experimentally produced in dogs. The toxin was not found in normal small intestine contents, or in contents of the large intestine even when obstructed, in human subjects.

5. Evidence is given compatible with the absorption of *B. welchii* toxin, from the clinical aspect of cases, from the occurrence of hæmolysis, and from microscopical changes in the heart and liver of fatal cases.

6. A therapeutic test of the hypothesis by the administration of *B. welchii* antitoxin in a series of cases of appendicular peritonitis and acute intestinal obstruction is reported.

7. Evidence is given, in the results of the therapeutic test, of clinical benefit to individual cases, and of improvement of the general mortality-rate in each series.

8. Practical details are given of the indications for the use of *B. welchii* antitoxin, and of dosage for the therapeutic test of the hypothesis.

9. Previous investigations of the toxæmia of acute intestinal obstruction are discussed, and a possible reason for their disagreement with the results of this investigation is suggested.

10. The results of the investigation and the theoretical and clinical applications are discussed.

Finally, I have to thank those whose assistance enabled this investigation to be carried out. As I knew little of bacteriology and nothing of anaerobe technique, the amount of help which I required was very great. In addition to those mentioned in the text, I am especially indebted to the following:—

Dr. S. C. Dyke, late Pathologist to the Surgical Unit, but now Pathologist to the Wolverhampton General Hospital, with whom the work was begun; Miss Muriel Robertson, of the Lister Institute, and especially Dr. R. A. O'Brien, of the Wellcome Research Institute, for his generous assistance with sera and *B. welchii* toxins; Sir Cuthbert Wallace, Director, and Mr. B. C. Maybury, Deputy Director of the Surgical Unit, St. Thomas's Hospital, who have given constant advice, suggestions, and criticism; Professor L. S. Dudgeon, Director of Pathology at St. Thomas's Hospital, for advice and criticism during the concluding stages of the investigation.

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A BONY TUMOUR OF THE BREAST.

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OSTEOID tumours are among the rarest of those occurring in the breast of the human being. So rare are they that although they were mentioned by Cooper. Nélaton, Cruveilhier, and Leser, their very existence was doubted by Billroth. The literature now, however, contains reference to a fair number of them. Deaver and McFarland¹ (1918) in their work, *The Breast*, take cognizance of these tumours and give a full bibliography. Lange² (1881) describes an 'osteochondroma' of the female breast; when removed this tumour was the size of a nutmeg, and had taken thirteen years to increase to this size from that of a berry. Happel³ (1895) describes a chondroma of the breast which attained the size of a goose egg a year from the time at which it was first noticed; thereafter it remained stationary for nine years, when it started to grow again and rapidly attained the size of a baby's head. Morton⁴ (1904) describes a small tumour removed, together with the breast and glands, which on examination proved to be a "spindle-celled sarcoma with areas of cartilage some of which was calcified." This is one of the few cases in which there is any later history; fifteen months from the time of operation a mass of similar growth was removed from the buttock, and later a like growth appeared on one finger. Morton states that five similar cases had been shown at the Pathological Society of London within the previous five years. Cornil and Petit⁵ (1905) describe a large nodular tumour removed from the mamma of a bitch; it consisted of areas of cartilage and bone formation scattered throughout the mammary tissue, and was considered by the authors to be due to a diffuse chronic inflammatory condition. They state that the condition is not uncommon in bitches. Sick⁶ (1906) describes a fatty tumour removed from a breast which contained numerous small points of cartilage formation, each surrounded by a fibrous capsule. Chevrier and Delval⁷ (1910) describe a 'fibro-myxo-chondro-ostéome' the size of a walnut removed from the female breast; it consisted of three tumours in coalescence, and was delimited, mobile, and non-adherent. Sehr⁸ (1907) describes a tumour consisting of miscellaneous and giant cells rich in chromatin, cartilage, calcification, and in certain areas showing bone formation. McIver⁹ (1923) describes a mass the size of a walnut removed from the breast of a woman aged 60. It consisted of "nondescript connective tissue and showed numerous mitotic figures. There were trabeculae of osteoid tissue scattered throughout it and occasional areas of cartilage. In one area an alveolar process with teeth could be made out". Kreibitz¹⁰ (1925) describes a tumour the size of a walnut the matrix of which consisted of spindle and giant cells and in which cartilage and bone

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were present; in one place was an area of 'carcinoma simplex'. He regarded the tumour as an osteosarcoma in combination with a carcinoma. Fowler¹¹ (1925) reports an osteochondroma of the breast occurring in a woman aged 67. Apart from the presence of cartilage and bone no mention is made of the cellular nature of this tumour. It had been present for ten months, and when excised proved to be 3 by 5 cm. in size.

PARTICULARS OF THE CASE.

Clinical History.—The patient from whom the tumour to be described was removed, was a single woman, age 50. She first noticed a lump in the left breast in December, 1924, when it appeared to be about the size of a hazel-nut; it remained about the same size and gave no inconvenience up to May, 1925, when it commenced to grow, the rate of growth becoming more and more rapid up to August of the same year, when the increase in size was, according to the patient, daily perceptible.



FIG. 187.—Photograph of tumour.

The breast was removed by Mr. S. Maslen Jones, F.R.C.S., at the Hospital for Women, Wolverhampton, in September, 1925, the whole organ being then about the size of a baby's head. Little doubt was entertained at the time of the operation but that the tumour was a carcinoma, and the axillary glands were cleared. The patient made a good recovery.

Description of Specimen.—The specimen as received in the laboratory consists of a greatly enlarged breast. Lying immediately under the nipple is a tumour, roughly circular and about 10 cm. in diameter. This tumour lies below upon the surface of the great pectoral muscle, which it does not invade, and extends above to the subcutaneous fat. Between this fat

and the tumour there exists a rather indefinite line of cleavage; this is not difficult to distinguish where the tumour comes into contact with the subcutaneous fat, but disappears where it lies over the muscle. In the centre of the tumour is a large cavity (*Fig. 187*) with ragged edges, roughly oval and having diameters of 5.0 and 2.5 cm. At operation this cavity was filled with blood-clot and débris, but had been evacuated when the specimen was received at the laboratory. The ragged nature of the edges of the cavity is due to the presence of numerous spicules of bone, and the whole tumour is firm in consistency and cuts in such a manner as to suggest the presence of bone. The outer surface of the tumour presents a greyish-white appearance. On making section through the whole breast, in addition to the large mass with a cavity in the centre, several smaller masses of the same tissue, showing extravasation of blood into their centre but no cavity, are apparent lying in the fat surrounding the central tumour. On superficial observation it appears as though one were dealing either with a tumour consisting of both fat and ossifying tissue, or of one large and several smaller ossifying tumours scattered throughout the fatty substance of the breast. On more careful examination it becomes apparent that the actual state of affairs consists of one large ossifying tumour, smooth at one of its edges, but with a number of irregular protrusions on the other side, these forcing their way into the fatty tissue of the breast, and giving on cross-section the appearance of separate tumours unconnected with the main mass.

On the smooth side of the tumour and under the nipple the edge of the tumour tissue is more or less definitely marked, but the boundaries of the projecting portions of the tumour shade almost imperceptibly into the surrounding fatty tissue.

Microscopical examination of the tumour shows that the most active and vegetative portion is the periphery (*Fig. 188*). Here two types of cell can be distinguished; the most plentiful, and that forming the bulk of the tumour tissue in this area, is a large spindle or round cell with a reticular type of nucleus. Interspersed among these, and increasing in number and size as the actual edge of the tumour is reached, are giant cells containing many small and deeply staining nuclei. The largest of these latter cells occur at the extreme periphery of the tumour where it abuts upon the normal tissue. In appearance they are indistinguishable from the giant cells of 'myeloid sarcoma' or from osteoblasts, or osteoclasts.

A short distance in from the edge of the tumour evidence of bone



FIG. 188.—Periphery of the tumour, showing absence of capsule, and cells of spindle and giant type.

formation commences (*Fig. 189*). Areas are present in which calcium salts are being deposited in the intercellular tissue, apparently without previous formation of cartilage.

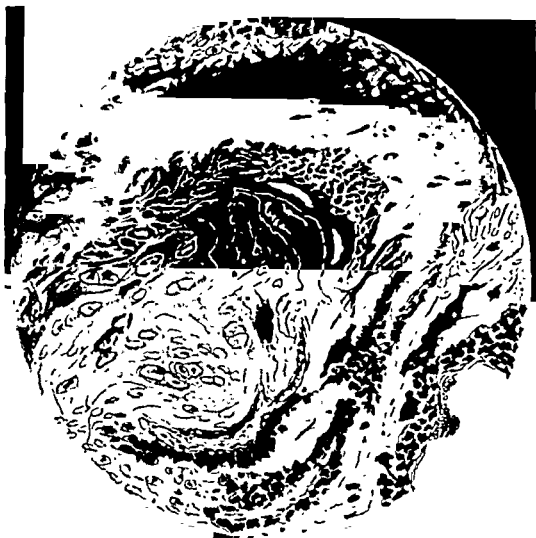


Fig. 189.—Portion of tumour deep to that shown in *Fig. 188*, showing formation of cartilage and bone.

In other places cartilage is being formed and calcified at the same time. None of the sections examined shows any considerable mass of cartilage in which calcification is not actively in progress. In no case is the process of calcification seen to be occurring in the immediate neighbourhood of the giant cells, and it would appear that it is not they but the spindle cells which are actively concerned in this process.

As the central portion of the tumour is approached, the consistency becomes harder. Decalcification was necessary before microscopic sections could be cut of the tissue abutting upon the central cavity. This

tissue shows ample evidence of ossification (*Fig. 190*). The general arrangement is loosely cancellous; many of the bony trabeculae show lacunae, some of which contain the remains of cells which may presumably be regarded as bone corpuscles. The trabeculae present no proper laminar structure; the spaces between them are filled in with necrotic cell debris; there is no attempt at marrow formation, and the remains of such cells as are distinguishable suggest that the original inhabitants of the intertrabecular spaces were of the spindle type described as constituting the mass of the tumour at the periphery. The tumour is obviously dying at the centre and increasing in size by growth at the periphery.

Microscopical examination of the tumour indicates that increase in size is taking place by a process of pushing back of the surrounding tissue rather than by definite invasion. The surrounding tissues show a considerable condensation of fibrous tissue,



Fig. 190.—Portion of tumour abutting upon central cavity, showing well-formed bone and absence of cellular elements.

almost sufficient in places to merit the name of a capsule. In other places this capsule formation is not so well marked, and spread of the tumour is taking place by invasion of the surrounding tissues by the cells of the tumour. Even where the fibrous-tissue capsule is fairly well marked, as in the portion illustrated, spread of the tumour cells into this fibrous tissue is quite evident. The appearances suggest a mild degree of malignancy.

Portions of the breast tissue abutting upon the tumour show marked change of the type usually described under the name of 'chronic mastitis'. These changes comprise dilatation of the acini, proliferation of their epithelium, and in some places the actual formation of new acini. In some areas cyst formation is a marked feature. There is nothing to suggest malignancy in the portions cut, though by some authorities the changes would perhaps be described as precancerous.

An enlarged gland removed from the axilla showed evidence of chronic inflammation, but none of malignancy.

Up to the time of writing, nine months from the time of the operation, there has been no recurrence of the tumour.

DISCUSSION.

The appearance in the breast of a tumour composed of such foreign structures as cartilage and bone seems difficult of explanation. Leaving aside the occurrence of metastases from tumours elsewhere, which would appear to be out of the question in any of the cases mentioned above, two explanations may be offered.

1. The condition may be a metaplasia following upon a chronic inflammation rather after the fashion of myositis ossificans in chronically irritated muscle.

2. The presence of the foreign cells may be the result of proliferation of totipotential cells which had become included early in embryonic life. In other words the tumours may be teratomata.

The first explanation may apply to certain of these cartilage- and bone-containing tumours. It is the view adopted by Chevril and Petit of the nature of their tumour in the bitch, and the description of Sick's tumour would suggest that his was something of the same sort. It is difficult to see how it can apply to many of the other similar tumours described above and to the tumour forming the subject of this note.

The second explanation would seem to fit in best with the case here described, and with most of those recorded in the literature. It is suggested by Ewing that the majority of these tumours are teratomata and fall into the same category as the mixed tumours of Wilms. The specimen described by McIver containing teeth lends very strong support to this view of the case. It is at first sight rather difficult to accept a tumour apparently consisting entirely of cartilaginous and osseous tissue as being teratoid in nature. One is in the habit of associating the teratomata with a mixture of many types of cells. It is, however, no unusual occurrence to meet with a teratoid tumour in which one type of cell has proliferated to a far greater extent than any of the others.

This is particularly the case where malignant change supervenes in one group of cells in a teratomatous tumour. Professor Haswell Wilson has pointed out to me that a very excellent example of this, of fairly common occurrence, is the overwhelming growth of cells of the chorionepithelioma type which may occur in teratomatous tumours of the testicle.

Further evidence of the teratomatous nature of these tumours would seem to be offered by Kreibig's case, in which areas of carcinoma were present. Kreibig was careful to point out that the appearances were not those of a sarcomatous change in a carcinoma, as described by Kettle¹² (1919), but a definite inclusion of areas of carcinoma within a sarcomatous tumour. The only circumstances capable of producing this state of affairs would seem to be the occurrence of malignancy in a teratomatous tumour.

It would seem probable that in the tumours of the type described above we are dealing with teratomatous mixed tumours of the breast in which one group of cells has assumed a speed of growth out of all proportion to that of the other elements present. This rapid proliferation must lead to a suspicion of malignancy. Morton's tumour demonstrated its malignancy by producing metastases, but this seems to have been the only case in which such definite proof has been forthcoming. Sehrt regarded his tumour as malignant on histological grounds. In the case described above evidence of a mild degree of malignancy was afforded by the invasion of the surrounding tissue by the tumour cells, though only to a slight extent, and the comparative failure of capsule formation.

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THE EXTRAPERITONEAL CLOSURE OF ARTIFICIAL ANUS (GREIG SMITH'S METHOD).

By T. CARWARDINE, BRISTOL.

IN 1895 the late J. Greig Smith published in the *Bristol Medico-Chirurgical Journal* a method of extraperitoneal closure of artificial anus,¹ and again in his book on abdominal surgery.² If certain points of importance in technique were understood, the method would be more popular; consequently a detailed description of the operation may be acceptable, with observations that are the outcome of experience, and a summary of results.

In Greig Smith's words: "The aim of the operation is to perform enterorrhaphy without opening the general peritoneal cavity; and this is managed by detaching from the parietes all round the fistula and anus sufficient peritoneum to permit delivery of the gut through a parietal incision without separating it from its peritoneal adhesions."

PRELIMINARY TREATMENT.

Preliminary treatment is necessary, and consists of division of the spur and restoration of a natural channel by mechanical means.

Division of the Spur.—There is no better or safer device for division of the spur than Dupuytren's enterotome if proper precautions are taken. Before its application the depth of the spur should be estimated by inserting the two gloved forefingers into the anus. Care should be exercised to select an enterotome the blades of which approximate first at a part corresponding with the apex of the spur. After the spur is clamped sufficiently to retain the enterotome in place the further compression should be gradual, the screw being turned about half a turn daily. It takes five or seven days for the spur to be crushed through. There is some risk of the enterotome being pulled out, hence the range of the patient's hands should be limited by a clove-hitch tied round each wrist and attached to the head-rail of the bed, or by some other means. There is risk also of the enterotome being pushed in accidentally; consequently the instrument should always be exposed to view and protected from accidental pressure. For this purpose a large perforated cork bung may be bisected at its diameter after cutting a groove in its circumference. The two halves are applied below the pivot of the enterotome and are tied together by a strong thread placed in the circumferential groove (*Fig. 191*).

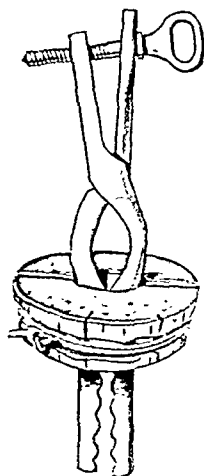


FIG. 191.—Enterotome protected by a divided cork.

Insertion of the Banks Tube.—The ingenious method of Mitchell Banks comprises the insertion of a piece of rubber tubing of considerable dimensions introduced on the stretch. It rests comfortably in the large entering gut, dilates the contracted efferent gut, and presses back any encroaching spur.

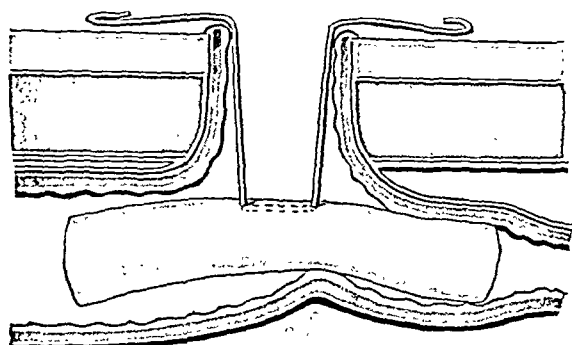


FIG. 192.—The Mitchell Banks tube in position, anchored by silver wire. Sectional view.

It is anchored by a piece of wire passed through its lateral wall which prevents the tube from being extruded and from being carried down the bowel (*Fig. 192*). It is inserted as soon as the spur is divided, to prevent the divided halves of the spur from joining again. There should be no haste at this stage; the longer the tube is kept in, the more natural will be the faecal flow, and the smaller will the artificial anus tend to become, thus making for ultimate success.

Use of the Button-valve.—The natural channel and normal defaecation may be further restored by using a valve to shut off the faeces from the surface. Since 1897 I have employed a valve (*Fig. 193*) of an oval piece of sheet rubber, or portion of a large drainage tube from $\frac{1}{16}$ to $\frac{1}{8}$ in. thick. This is rolled up and inserted into the artificial anus, when it

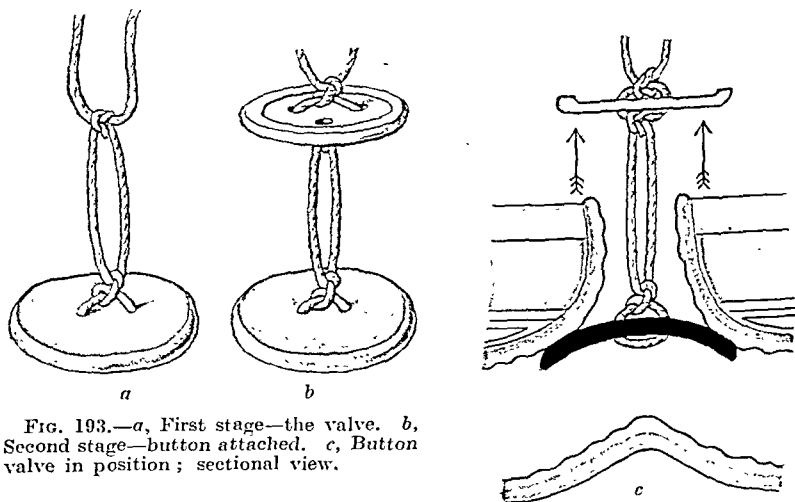


FIG. 193.—*a*, First stage—the valve. *b*, Second stage—button attached. *c*, Button valve in position; sectional view.

opens up within the bowel and acts effectively. Through its centre a double thread or string is passed and knotted, and the string is knotted again at a convenient distance—generally about $\frac{3}{4}$ in. Then a large coat-button is threaded on the double string, which is knotted once again, and

the excess of thread is cut off. When the valve is inserted the button provides a means for supporting it against the internal aperture of the anus, merely requiring some gauze or lint to be wound round the string underneath the button.

The button-valve was used for some of Greig Smith's cases, and it was published and illustrated in 1900. It is a very useful device and may be used elsewhere; by its means the life of a patient with a large gastric fistula has been saved, the fistula closing entirely. A smaller valve may be used as the anus reduces in size. Harrison Cripps employed a roll of lint for a similar purpose, and in 1917 C. N. Dowd described and illustrated an obturator acting on the same principles, the inner valve being made from an ovoid piece of flat wood.³

The preliminary mechanical treatment is of very considerable help; indeed, in some cases natural defæcation is restored and the artificial anus becomes very small. It is tedious at first—the only objection to it; but it is safe and generally sure, and extraperitoneal closure can be proceeded with subsequently.

TECHNIQUE OF EXTRAPERITONEAL CLOSURE.

The extraperitoneal cure may be described in four operative stages: (1) *The incision*; (2) *The separation of the bowel*; (3) *The suture of the opening of the bowel*; (4) *The closure of the wound*.

1. **The Incision.**—To quote Greig Smith's words: "The operation is begun, as in that for fistula, by making incisions along the direction of the chief muscular fibres on each side of the opening down to the subperitoneal tissue. The length of the incisions will vary according to the thickness of the parietes, but will not be shorter than two inches on each side of the anus. The knife is carried round the gut adherent to the parietes, liberating it thoroughly." It was Greig Smith's practice to include a certain amount of skin if necessary, which, when inverted, increased the lumen of the bowel at the part; and I have done so in the majority of instances. It matters little in which direction the skin-flaps are taken, but their shape is important in view of subsequent inversion and suture. They are best made of a semilunar shape, the incisions meeting the mucous edge at the two poles of the diameter (*Fig. 194*). When skin is included the incision should not be oval and uniform all round the anus; such a shape makes the suturing and inversion more difficult.



FIG. 194.—The incisions.

2. **The Separation of the Bowel.**—"The peritoneum, with its areolar tissue, is separated from the overlying muscle all round over a circle of two inches radius or more. The bowel, with its adherent parietal peritoneum, is then delivered through the incision. All superfluous pieces of tissue are removed, and the gut is ready for suture." "The most important detail is liberation of the gut by detachment of the parietal peritoneum. If detachment

is well begun at the distal ends of the incisions, and the plane of separation is followed up to the very margin of the fistula or anus, the operation is much simplified." This important liberation of the gut needs some explanation in detail, which we may illustrate in a case of left inguinal anus.

The longitudinal incisions in the skin are deepened until the aponeurosis of the external oblique is recognized with its muscular fibres at the upper angle (*Fig. 195*); its fibres are divided distally and the division is continued to near the artificial anus; then the finger is swept under the external oblique to set it free from the artificial anus and from underlying tissues. Here, and in later stages, Greig Smith's dissecting scissors of proper pattern are very useful.



FIG. 195.—Superficial separation of the bowel.

Then the muscle fibres of the internal oblique, incorporated with those of the transversalis, are identified. These are undermined, beginning well to the *distal* ends of the incisions until the subperitoneal tissue is reached, where the forefinger can be inserted and swept round. Near the artificial anus the muscle fibres will be adherent and may be divided there with dissecting scissors or a sharp scalpel; but it is best to insert the finger under the distal part of the muscle and to pass the blades of the scissors between the finger and the edges of the artificial anus

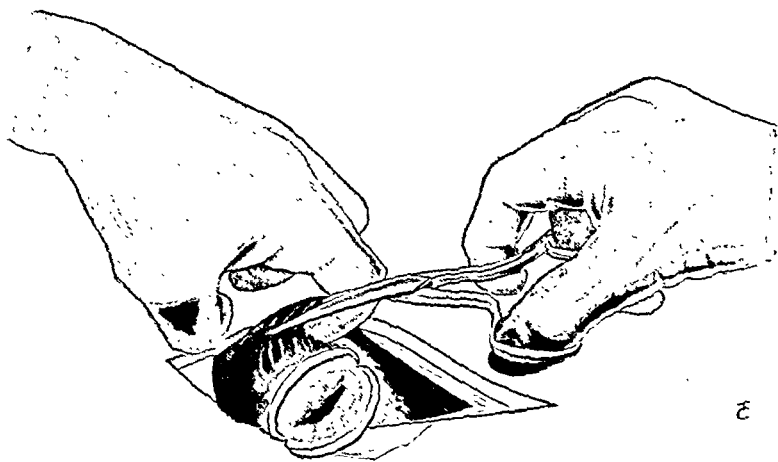


FIG. 196.—Deep separation of the bowel, showing the use of Greig Smith's dissecting scissors and the protection of the peritoneum by the left forefinger.

(*Fig. 196*). If a small hole is made into the peritoneum accidentally, there need be no anxiety, for experience shows that it never leads to trouble. Care should be taken to free the aponeurosis and musculature as separate layers so that they may be approximated later with the least possible tension. It should now be possible—and the test should always be tried—to lift the bowel right out of the wound and to drop it with ease into the

abdomen, although 'extraperitoneal' (*Fig. 197*). If this free mobilization can be carried out, the chances of a successful closure are great. It is the crucial stage of the operation, and the one which has not been appreciated as it should be.

3. Suture of the Opening of the Bowel.—All superfluous pieces of tissue are removed. The trimming should be thorough, especially if skin-flaps are

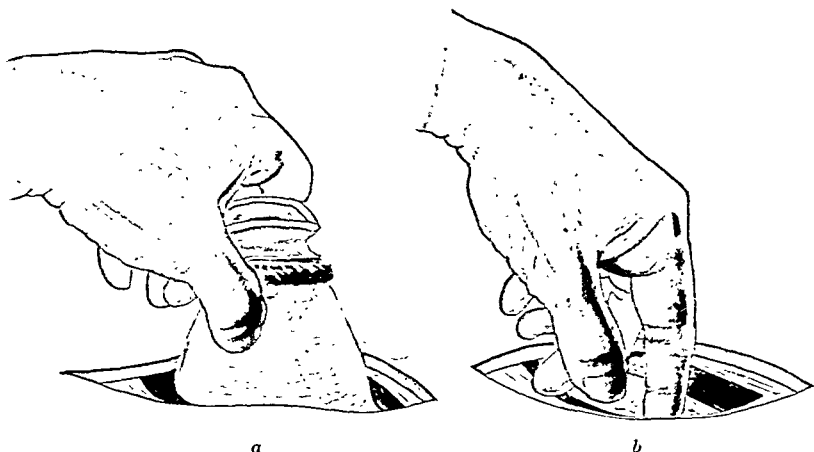


FIG. 197.—Free mobilization of the bowel. *a*, The bowel lifted right out of the wound, showing the free mobilization—very important. *b*, The bowel placed within the abdomen, the anus extraperitoneal.

utilized, so that the edges may be inverted without tension. The edges are sutured with inverting continuous catgut stitches, using a round-bodied needle for mucous membrane or a fine bayonet-pointed needle for skin-flaps. It is best to begin the suturing of the opening at each end and to tie the ends of

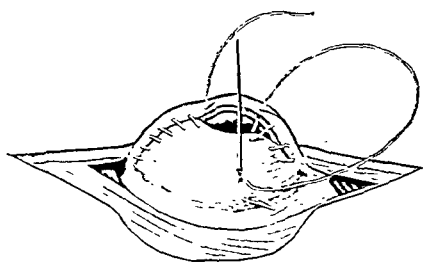


FIG. 198.—Suturing the edges of the opening in the bowel. The two sutures are begun at the ends and tied together in the middle.

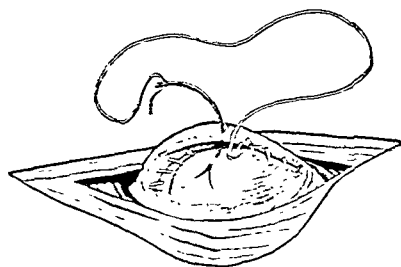


FIG. 199.—Reinforcing suture inverting the tissues and burying the previous suture.

the sutures together in the middle (*Fig. 198*); the intucking is thus more perfect and a terminal pocket which is difficult to invert is avoided. Next a reinforcing continuous catgut suture is passed, Lembert fashion, to invert the edge still further (*Fig. 199*); the tissue is fibrous and a strong hold can

be taken, using a triangular-pointed needle. Then a further reinforcement can be made by a few interrupted sutures. "Particular care is given to the deep suturing. A good hold of the tissues is taken, and each stitch must bring about accurate apposition." A trace of antiseptic is then applied with a gauze swab, such as a little iodoform powder, and successive layers are so treated with antiseptic after suturing.

4. **Closure of the Wound.**—This should be done by four or five through-and-through sutures, including skin, aponeurosis, and musculature.

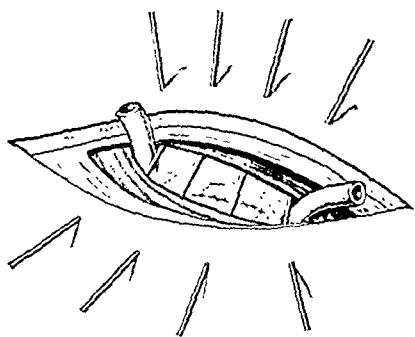


FIG. 200.—Method of closure and drainage of the wound.

They may be of stoutest silkworm gut or of silver wire, and merely bring about apposition without undue tension. I have used silver wire in most cases: it is stronger, causes less irritation, is less likely to cut through, and it is not very painful to remove after the cut ends have been straightened out. At each end of the wound a small drainage tube must be inserted down to the subperitoneal tissue (*Fig. 200*). Although not always necessary, the musculature and the aponeurosis may have a few interrupted sutures of strong catgut inserted, but excessive suturing is to be

avoided here. No sutures are put in the skin other than the deep through-and-through sutures. An antiseptic dressing is then applied.

SUBSEQUENT COURSE.

Natural defæcation is the rule, and frequently the wound heals quickly and securely. At the end of five days or a week there may be a slight fecal discharge, which ceases during the next fortnight. Occasionally the wound breaks down completely, but after waiting two or three months the operation may be repeated with perfect success. In one of my cases a minute permanent fistula remained which discharged at times. The risk of temporary failure appears to be greater in the left inguinal region than elsewhere. It is here that the spur is thicker, being composed of the compressed portion of mesosigmoid; and in one case at this site end-to-end union had to be performed after an unsuccessful attempt at extraperitoneal closure.

The Mortality.—The death-rate is very low: in the absence of serious complications it should be well under 5 per cent. Of 38 cases recorded in the appended table there were 3 deaths, each with complications—previous gangrene of the bowel, cancer in the pelvis, and previous perforative peritonitis. Enterectomy by a two-stage method—Paul's method—is admittedly the safest for the large bowel, especially with intestinal obstruction, even with preliminary cæcostomy. If a comparatively safe and satisfactory method of extraperitoneal closure of the resulting artificial anus is added, the two combined have a lower mortality than other procedures, and are applicable to many conditions, as shown in the following table.

OPERATIONS FOR EXTRAPERITONEAL CLOSURE OF ARTIFICIAL ANUS.

PRIMARY CONDITIONS	AGES	No.	REMARKS
<i>Successful (34)</i>	Years		
Cancer of rectum	41	1	—
Cancer of colon	46-64	11	One double simultaneous closure
Cancer of sigmoid	35-74	5	Patient, age 74, was well three years after
Sigmoidectomy for prolapse, rectal and uterine	60	1	Permanent minute fistula
Irreducible intussusception	1 $\frac{1}{2}$ -11	3	See text.
Sigmoiditis	60-77	3	One with large hernia, and bowels acted naturally after six years
Sigmoiditis (sigmoidectomy)	37	1	Second operation successful
Volvulus	40	1	—
Sloughing following appendicitis	21-30	2	Operation had to be repeated in one
Fæcal mass, peritonitis	50	1	—
Intestinal obstruction	47-56	2	In one, colostomy done at sea
Traumatic colostomy	—	3	War injuries
		—	
		34	
<i>Unsuccessful (4)</i>			
Cancer of rectum	46	1	Extraperitoneal a failure, successful end-to-end union
Gangrenous intestine	33	1	Death
Cancer of colon	70	1	Pelvic cancer present
Cancer of sigmoid with perforative peritonitis	65	1	Death two days after: bronchitis
		—	
		38	
		—	

Total Deaths, 3: one with gangrenous intestine, one with secondary cancer, and one with cancer and perforative peritonitis.

APPRECIATION.

The disadvantages are the loss of time and the two stages of operation, but these disadvantages are small compared with the gain in life. In rather more than half the cases the artificial anus had been required for *cancer* with obstruction; in one of these there had been perforation with peritonitis, and in another the cancerous mass burst at the time of the initial operation. The oldest patient was 74, with cancer of the sigmoid, and she is still well three years after the extraperitoneal closure. The youngest patient was 1 year and 7 months old. Three cases of *irreducible intussusception* in children have been treated by a two-stage enterectomy, with drainage of the upper bowel by tube or by lateral anastomosis, followed by an extraperitoneal closure of the artificial anus, all successfully; I submit, therefore, that the method is safer than primary excision or excision of the intussusceptum. There were 4 cases of *sigmoiditis*; in 2 of these colostomy had been done for supposed cancer with obstruction, the tumour disappearing subsequently. In one of these a very large hernia at the site of the colostomy was cured at the same time as the extraperitoneal closure was done, and it is of interest that the bowels act

naturally, although for six years all fæces had passed through the artificial anus. A third was a two-stage resection for diverticulitis which required a second, and successful, attempt at closure of the artificial anus. In one patient *two artificial ani* were successfully closed at one time, inguinal and left lumbar, the inguinal anus having been made for obstruction, but below the growth in the splenic flexure. The cure of artificial anus of the *small intestine* has proved to be as satisfactory as that of the large, after preliminary treatment of the excoriated skin, in which the 'button-valve' has played a valuable part.

Although the method was published over thirty years ago and I have employed it since 1898, there have been few references to it in literature. The closure of colostomy openings was discussed at a meeting of the Royal Society of Medicine in 1917. Several speakers mentioned the success of the extraperitoneal method, but the opener of the discussion said it left the gut outside the peritoneum and with a narrowed lumen, that the patients generally have chronic constipation and a weak place in the abdominal wall which requires the use of a support.⁴ Properly performed, however, only the closed artificial anus is extraperitoneal and the gut is within the peritoneum. None of my patients has had a weak place in the abdominal wall, and none has worn a support, even when, as in one case, a large hernia the size of two fists was cured at the time of extraperitoneal closure.

Sinclair White advocated the method very strongly in the *Lancet*, and rightly remarks: "The one factor which makes the operation so much safer than resection of the bowel is that the mesenteric side of the colon with its vascular and nerve-supply is not interfered with."⁵ Four years previously he wrote: "All the fatalities I have had in my private practice occurred in cases where the single-stage operation was done, and I am so firmly convinced of the superiority of the two-stage procedure that I have employed it exclusively for the last five years".⁶ His experience was supported by Ernest Finch.⁷ Robert C. Coffey⁸ has reported a method of extraperitoneal closure which in all essential respects is similar to that described and practised by Greig Smith, whose memory we revere and whose method we would like to endorse and perpetuate.

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SARCOMATOUS PERMEATION OF THE INFERIOR VENA CAVA AND RIGHT SIDE OF THE HEART.

BY H. J. B. FRY AND C. E. SHATTOCK, LONDON.

THIS case of intravascular sarcomatous growth is worthy of record not only on account of the length and continuity of the growth within the vascular system, but also for its unusual relation to the heart and vessels. As will be seen, the growth entered the inferior vena cava at its origin from the common iliac veins, traversed its whole length, forming a solid cast of the vessel, went through the right auricle and orifice of the tricuspid valve and the cavity of the right ventricle, and passed out through the pulmonary valve into the pulmonary artery as a solid cord. Portions here became detached and formed emboli in the lungs. The length of the growth within the vascular system as a solid mass was not less than 53 cm., with an average diameter of 5.5 cm.

This extraordinary growth formation must have been in existence for some months prior to death; yet it did not cause very severe vascular symptoms apart from œdema of the lower part of the body, in spite of the almost complete blocking of the inferior vena cava and right side of the heart, permitting the passage of only a thin peripheral layer of blood.

NOTES OF THE CASE.

M. C., age 19, primipara. Admitted Nov. 12, 1924, under Mr. Shattock.

HISTORY.—The patient was delivered of a full-term child four months previously without the aid of instruments. The child weighed 7 lb. 6 oz. During the last six months of pregnancy the patient was numb on the left side from just above the hip down to the knee, but no numbness was present elsewhere. On getting up ten days after labour, she complained of patches of numbness on sitting down, and there was numbness in the right leg from hip to knee, but none at all on the left side. The patient at this stage could not walk properly, being 'drawn over' on the right side and having difficulty in sitting down. Four weeks after her delivery she complained of severe pain in the lower part of the back, and her temperature was over 100° F. For the three months preceding admission to hospital she had complained of severe pain in the back, aching in character, relieved by standing up. The numbness in the right lower limb extended to the foot, but varied in degree. She complained of aching in the right leg, especially on walking, but no pain was felt in the left leg. There had been marked constipation for the past four months, but not previously. She had been getting thinner and had lately some difficulty in micturition.

ON ADMISSION.—When admitted to hospital on Nov. 12, 1924, the patient looked pale and thin. She walked with the right knee flexed and

the right heel raised off the ground, owing to pain. The movements of the right lower limb were somewhat weak. Objective sensation was normal in the right leg and thigh. The left lower limb showed no muscular weakness or sensory change. There was anæsthesia of the perineum both to pinprick and cotton wool, the area of anæsthesia extending down the upper part of the back of the right thigh. Knee-jerks present; plantar reflexes present and flexor in type.

Pelvic examination demonstrated a large hard mass projecting forwards from the sacrum, to which it was attached by a broad base. The mass extended more to the left of the middle line than to the right. Its upper border could not be reached. X-ray examination showed a large irregular shadow of the density of bone superimposed on the sacral promontory.

Laparotomy revealed a large hard tumour growing from the sacrum, extending widely upwards and laterally. A small piece of the growth was removed by a perineal incision for histological examination, and radium was inserted through this incision. The pathological report showed ossifying chondroma without malignant changes in the portion removed.

SUBSEQUENT PROGRESS.—The patient developed urinary incontinence. She suffered with pain in the back and sharp pains in the right foot, especially on movement. Increasing weakness of the lower limbs and pain in both legs kept her bedridden, both legs being hyperæsthetic. An irregular pyrexia occurred at times.

Towards the end of her life enormous œdema of both lower limbs and vulva developed. The œdema later involved the abdominal wall. Multiple nodules of growth in the subcutaneous tissues of the buttocks and hips appeared, and a large growth was visible. The patient lived for several weeks in this condition of marked œdema, and died finally with uræmic symptoms twelve months after the birth of her child and eight months after first coming under observation.

PATHOLOGICAL REPORTS.—The Wassermann reaction upon the blood was negative. The piece of tissue removed at operation showed cartilaginous tissue with some areas of calcification and osteoid tissue, but there was no definite evidence of sarcomatous change, and the growth was diagnosed as an ossifying chondroma.

POST-MORTEM EXAMINATION.—This showed marked œdema of the lower extremities and the lower part of the abdomen, and there was some swelling of the face and neck. On incision, the subcutaneous tissues of the abdomen poured out œdematous fluid, but there was no ascites. In the region of the sacrum was a large mass lying behind the peritoneum, almost filling the cavity of the pelvis and extending up into the lumbar regions. The growth arising from the sacrum was smooth, firm, with a slightly nodular surface, and its limits could not be defined. It was covered by cartilage below in the pelvis, but above in the region of the psoas muscles and in the inguinal regions the growth was gristly, with calcareous areas.

The inferior vena cava was greatly distended and at first hardly recognizable, being a rounded semi-solid pillar extending from the junction of the common iliac veins to the lower surface of the diaphragm. It appeared to be completely thrombosed. The common iliac vessels on both sides were

involved and compressed by the growth. The renal veins were not invaded. The lumen of the inferior vena cava was occupied by a mass of firm, whitish, gristly consistency which extended through the right auricle into the right ventricle and passed out as a solid cord through the pulmonary valve into the pulmonary artery (*Fig. 201*). The growth had a vermiform appearance, with its surface broken up by small gyri and sulci, giving it a nodular glistening character. On longitudinal section the mass is seen to be composed of growth and organized thrombus compacted into a solid mass, with reddish clots in a few central areas. The superior vena cava was free from growth and contained post-mortem clot.



FIG. 201.—Vena cava and right heart filled with growth and thrombus.

The pleural cavities contained a considerable quantity of clear fluid. The lungs were partially collapsed, and the lower lobes on both sides contained a few small rounded whitish nodules of growth in their substance.

The thoracic aorta was rather small in calibre, and the abdominal part was compressed. The lumbar veins were distended. The liver showed changes due to marked passive venous congestion, with fatty degeneration. The spleen was small and tough. The mucous membrane of the stomach showed œdema and superficial areas of necrosis. The ureters were compressed by growth on both sides as they crossed the brim of the pelvis. They were dilated above this point, and the kidneys showed the changes of early hydronephrosis. The adrenals were healthy. The uterus and appendages were normal.

Death was due apparently more to uræmia than to the growth or its immediate effects.

MICROSCOPICAL EXAMINATION.—

1. *Sacral Growth*.—The tissue shows a fairly dense fibrous stroma interpenetrated with more or less dense aggregations of spindle or polymorphic cells resembling young fibroblasts, forming a meshwork. Here and there throughout the tissue are cartilaginous areas undergoing varying degrees of calcification. The cells described above are of fairly regular size. The nuclei are not abnormal in appearance and show few mitoses. This tissue varies from that taken at operation, in the smaller amount of cartilage present and the increase in the fibrocellular tissue and in the areas of calcification. These differences

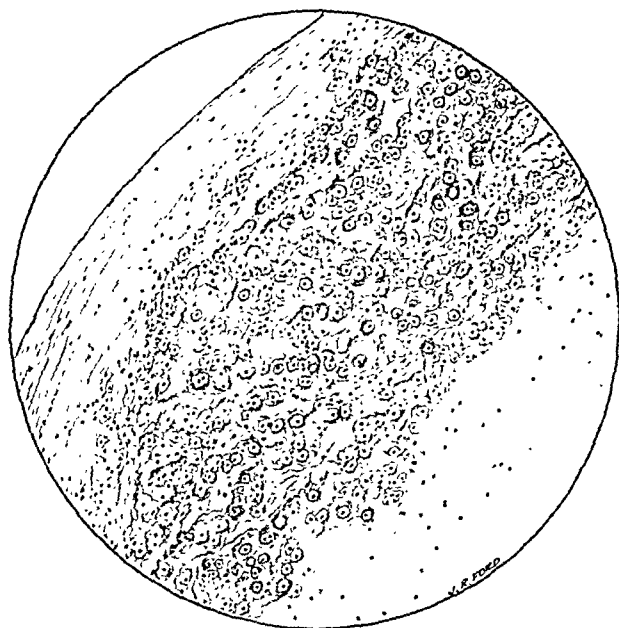


FIG. 202.—Section from growth in vena cava.

may obviously be due only to the nature of the samples taken in each instance.

2. *Growth in the Inferior Vena Cava*.—In this tissue, immediately beneath the wall of the vessel is a layer of well-formed cartilage cells, separated from the wall here and there by a thin layer of fibrin and red cells. The cartilage cells are more regular than in the sacral growth, and show minute traces of calcareous deposit only at some points. The fibrocellular tissue is much less evident, and is seen only in relation to the cartilage or in small isolated nests of sarcomatous cells. Internal to this layer

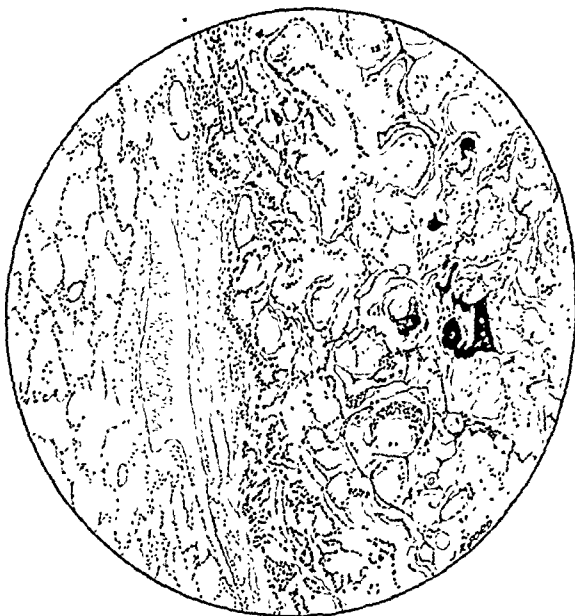


FIG. 203.—Section from nodule in lung.

Internal to this layer

is an almost structureless thrombus, partially organized, in which can be recognized with difficulty a fibrin network and red cells. This is partly penetrated by the sarcomatous cells (*Fig. 202*).

3. *Lung Nodule*.—This contains no true cartilage, but is composed chiefly of condensed masses of white fibrous tissue embedded in the alveoli of the lung, with rather numerous foci of calcification towards the centre of the nodule, where the fibrous tissue is less compact, forming wide meshes. At the periphery of the nodule are grouped the sarcomatous cells. Here they are more definitely spindle-shaped or form small syncytial masses, and are relatively numerous. There is a capsule of condensed lung tissue (*Fig. 203*).

REPORTS OF PREVIOUS CASES.

An intravenous and intracardiac growth of such size and continuity seems rarely to have been reported. The following are the only cases of similar character which we have been able to discover. Sir James Paget¹ in 1855 described a malignant enchondroma of the testis, which permeated the lymphatics of the spermatic cord. A secondary mass in front of the inferior vena cava pierced the latter and formed nodules on its inner surface and in many of the larger branches of the pulmonary arteries, producing secondary deposits in the lungs. This tumour was re-examined forty years later by Kanthack and Pigg² and considered by them to be a columnar-celled carcinoma, but was again examined by Nicholson⁴ and regarded by him as an embryoma, derivatives of all three embryonic layers being present (*Case 60*).

Kanthack and Pigg³ gave a report of another case of columnar-celled carcinoma of the testis in which the lumbar glands were invaded. From this a mass protruded into the inferior vena cava, extending upwards within its lumen, sending a lateral offshoot into the right renal vein. On the tricuspid valve was a dendriform mass extending through the right auricle into the inferior vena cava and into the right ventricle. The lateral branches contained small cysts filled with clear fluid. The authors consider that a fragment of the intravenous growth had become separated and grafted upon the tricuspid valve.

Parkes Weber⁵ described a case of bilateral malignant adrenal carcinoma, in which there was thrombosis extending into both iliac veins below, and upwards to the right side of the heart, where it terminated in a rounded mass which projected into and partially filled the right auricle. This specimen is in the Museum of the Royal College of Surgeons, London, under catalogue number 2033.1. Examination of the clot at this point showed that it was infiltrated by the same form of malignant growth. There were secondary nodules in the lungs and liver. The patient died of uræmia.

French⁶ reported a case of spheroidal-celled carcinoma of the left kidney which spread into the left renal vein and thence into the inferior vena cava, causing progressive thrombosis with malignant infiltration of the clot. This process continued up to the formation of a large polypoid mass in the right auricle, causing a tricuspid stenosis of the ball-and-socket type.

DISCUSSION.

The unusual length and continuity of the growth in the heart and in a vessel of such wide calibre are the chief features of pathological interest. Sampson Handley showed that the permeation of the lymphatics by carcinoma occurs chiefly in vessels of 40 to 50 μ in diameter, avoiding the larger trunks where the force of the stream may be strong enough to sweep the cells away as emboli. The hard and elastic nature of the tumour in this instance probably aided its extension along the vena cava and prevented its being broken up by the blood-stream on its entry into the lumen of the vessel, which the thinness of the wall made easy. The comparatively slow character of the growth and its relatively low cellular content not only assisted the great extension of the growth, but also permitted the gradual re-adjustment of the vascular mechanism. The enlargement of the veins of the anterior abdominal wall, to which Weber has drawn attention in thrombosis of the inferior vena cava, was not a feature in this instance. It is remarkable that in this case, and in those quoted above, the patient lived so long and died finally of uræmia.

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THE SURGERY OF THE JEJUNUM.

(Being a Hunterian Lecture delivered at the Royal College of Surgeons of England on February 3, 1926.)

By JOSEPH E. ADAMS, London.

To the anatomist the jejunum is the upper two-fifths of the small intestine; to the surgeon it is that portion which begins at the duodenojejunal flexure and does not descend into the pelvis. It might appear that its surgery need hardly be considered apart from that of the rest of the small intestine; but I think a separate consideration of it may be worth while, especially in view of the fact that of recent years the operation of gastrojejunostomy has brought in its train troubles which affect the jejunum alone.

TRAUMATIC LESIONS.

Although the jejunum is nowhere protected by any covering but muscle, the incidence of small-intestine rupture is about equal in both jejunum and ileum. It may be that the relative emptiness of the jejunum affords some immunity. If it is accepted that the three possible mechanisms, a crush, a tear, or a burst, are the factors responsible for intestinal rupture, I think we may take it that the last very rarely affects the jejunum. Sir James Berry¹ found that 90 per cent of cases of intestinal rupture occurred in males, mostly between the ages of twenty and fifty. Undoubtedly fixed portions of the intestine are most susceptible to tearing. The commonest cause of intestinal rupture is a direct blow on the abdominal wall by some object which involves only a small area but will push its way on so that anterior and posterior walls temporarily come into contact. What happens to the bowel between them depends on its fixity and its state of distention. If the rupture occurs at, or close to, the beginning of the jejunum, I think it is right to infer that the lesion is a tear. Massie,² in reviewing 34 cases at Guy's Hospital involving all parts of the bowel from stomach to rectum, found nearly 50 per cent in the jejunum, and half of these again were within eighteen inches of the duodenojejunal flexure.

The clinical aspect of intestinal rupture has been very closely studied, and no description of the physical signs is needed here; but an inspection of hospital statistics does reveal the fact that many cases are watched for hours after admission before operation is undertaken. The most important point to be considered is the nature of the accident. If the abdomen has been struck by the hoof of a horse, the pole of a cart, the dumb-iron of a motor car, this in itself may often be sufficient justification for abdominal exploration. The prognosis can only be hopeful where operation is for rupture of the intestine and not for perforative peritonitis. Marked rise in the pulse-rate, recurrent vomiting, diminution of liver dullness, and abdominal rigidity are all

late signs. Local hyperæsthesia should be a sign of value, but, unfortunately, it is often unreliable on account of bruising of the abdominal wall. If no improvement takes place within two hours of the injured patient's being put in a well-warmed bed, it is highly probable that internal visceral damage is present, and the abdomen should be explored.

The prognosis of rupture of the jejunum is governed chiefly by the state of emptiness or otherwise of the bowel, and by the time which elapses between operation and the receipt of the injury. The time of the last meal should therefore be ascertained.

It is remarkable that in not a few cases a very slight fall on the flat abdomen has been responsible for rupture of the intestine. In most of these the accident has occurred shortly after a full meal. These are probably examples of bursting of the gut owing to its sudden compression at two or more points (Hain).³

The method of suture should be such as will avoid serious narrowing of the bowel lumen, and in cases of multiple or extensive ruptures resection may be necessary.

RESECTION OF SMALL INTESTINE.

This brings one to a consideration of the amount of small intestine which can be removed with safety. In this connection Pirrie Watson⁴ quotes a case, recorded by Denk in 1910, where Bremer removed 17 ft. 9 in. for strangulated femoral hernia. The patient, who was a woman of 61, made a good recovery, and she lived for two and a half years, ultimately dying of marasmus. The only obvious defect in her metabolism during this period was a slight failure of fat absorption. It is clear, therefore, that the jejunum is a portion of the bowel which can be dispensed with, and, experimentally. Flint⁵ found that 50 per cent of the small intestine could be safely removed from dogs. They lived on indefinitely in good condition, and the resultant early diarrhoea soon ceased. Compensatory hypertrophy of the remaining mucous membrane takes place, but there may be evidence that fats are not absorbed, and dietetic error may quite easily lead to enteritis and marasmus. Fractional resection is more readily tolerated, even up to 75 per cent of the small intestine.

Removal in the human being of small bowel up to two-fifths of its length makes little difference to metabolism, but I have been unable to find any case on record where the portion removed consisted of the whole jejunum. Most of these resections involve ileum rather than jejunum, since the type of lesion calling for such drastic surgery is likely to be a gangrenous strangulated hernia. The absorptive surface of the jejunum is greater, because the valvula conniventes are more pronounced in the upper intestine, and for this reason perhaps jejunectomy is more likely to upset metabolism than ileectomy.

DIVERTICULA OF THE JEJUNUM.'

I do not propose to discuss the etiology of these protrusions or pockets in the wall of the jejunum, and I believe the distinction between 'false' and 'true' is largely an artificial one. Obviously, as any such protrusion increases in size it will tend to stretch the muscular coat, and this may lead to atrophy;

thus we get the change from a true to a false diverticulum, from so-called diverticulitis to sacculaton. As one would naturally expect, this condition is rare in the jejunum, and the probable explanation is the relative absence of a high or persistent intra-intestinal pressure. Writing in 1921, Hunt and Cook,⁶ quoting Case,⁷ stated that from 1854 to 1920 only 17 certain cases had been recorded of diverticula in the small intestine; but Helvestine,⁸ two years later, refers to 27 cases of false diverticula in the jejunum alone. Probably, therefore, the increasing frequency of opaque-meal examinations is bringing more cases to light. How far they are likely to be responsible for symptoms is problematical. Epigastric pain with tenderness and nausea are alleged to be attributable in some cases to their presence. My own clinical acquaintance with diverticula is limited to the duodenum and sigmoid colon.

The most striking example of jejunal diverticula was recorded by Braithwaite⁹ in 1923. This patient was a man of 54, giving a history of dyspepsia for over thirty years. He had pain and nausea about one hour after food, with noisy flatulence. The symptoms were relieved about two hours later by the evacuation of wind, either by the mouth or anus. Vomiting took place three or four times a week, and on one occasion he had a profuse hæmatemesis. His symptoms before operation were attributed to tuberculous peritonitis. The jejunum showed no fewer than fifty diverticula along its mesenteric border, and presumably all the coats were involved. The highest was situated at the duodenojejunal flexure, and their size varied from that of a tangerine orange to a pea. Four feet of the bowel were successfully excised, and no other diverticula were discovered in the abdomen. The specimen is most remarkable, and affords abundant scope for theorizing as to the causation of such diverticula.

THE JEJUNUM AS THE SEAT OF INTESTINAL OBSTRUCTION.

The higher the obstruction, the more urgent the symptoms of pain and vomiting. Jejunal obstruction, if unrelieved, rapidly terminates fatally. This portion of the intestine may be implicated in any of the ordinary forms of obstruction, whether it be internal hernia, adhesions, intussusception, volvulus, or due to new growth. Naturally its relationship to the duodenal fossæ makes it almost certain that an internal hernia in this region will involve the jejunum. Of the other causes of obstruction probably adhesions are the commonest. Intussusception is rarely met with in this part of the small intestine. That volvulus may occur apart from the presence of initial adhesions or abnormal mesenteric arrangements appears certain. Irregular peristalsis must in such cases be responsible, and this may be caused by injudicious or excessive feeding, or the misuse of aperients. Inherent irregularities in the muscles of the bowel wall may be a necessary factor, and Carey, quoted by Tees,¹⁰ has shown that in some animals the musculature of the intestine does not consist simply of an inner circular coat and an outer longitudinal one. Instead of this the inner coat may form a closely-wound spiral and the outer a more elongated spiral. I am not aware that this state of affairs has ever been found in a human subject, but irregular peristalsis of such muscular coats might easily be responsible for volvulus and consequent obstruction.

I operated upon a case involving some eight inches of the jejunum a few years ago, but unfortunately I have been unable to find the specimen. The gut was gangrenous and the affected bowel was resected, but three or four days later the patient died for no very obvious reason, since the anastomosis was perfect and there was no peritonitis. Probably a temporary jejunostomy should have been added to the resection to save the patient from toxæmia, and the argument in favour of this proceeding may now be considered.

The question of first importance with regard to obstruction of the small intestine is the precise explanation of its high and rapid mortality. Many investigations have been made to elucidate this problem, and the researches of Stone, Whipple and Bernheim¹¹ are no doubt familiar. It is generally admitted that death resulting from acute obstruction is due to the absorption of toxic material developed within the obstructed bowel. From artificially obstructed loops in dogs the poisonous fluid may be abstracted. When it is injected intravenously into healthy animals death ensues with symptoms precisely similar to those presented by the dogs with obstructed loops. Such animals exhibit, according to Stone,¹² "a marked and rapid fall of blood-pressure, temperature disturbances, excretion of large amounts of fluid into the intestinal canal, with vomiting, diarrhœa—sometimes bloody—and fatal shock."

A marked engorgement due to vascular dilatation of the mucosa of the digestive tract, especially the duodenum and jejunum, was a feature of the autopsy findings.

The source of these toxins and their chemical nature is still the subject of controversy. Whipple¹³ himself has maintained that the poison is a product of the mucosal wall, especially of the duodenum, but many workers, notably the Dagstedts,¹⁴ have disputed this conclusion, and have found that bacteria and the results of bacterial activity are necessary to the fatal issue. Closed loops of bowel freed from bacteria are quite compatible with health. Protein substances are acted upon by bacteria in closed loops not rendered free from organisms, and of all the products proteoses appear to be the most toxic. Such toxins must be absorbed and reach the general circulation in order that lethal results may follow, and a moot point is whether the mucous membrane of an obstructed loop can or cannot absorb these substances. Whipple maintains that it cannot, but others hold that the circulatory changes in the mucosa, with tissue necrosis due to bacterial action, do cause absorption to occur. Stone¹⁵ suggests that the toxin, or toxins, present in the obstructed gut, bearing a resemblance to histamine, themselves cause increased tone and peristalsis in the bowel. Vomiting does not remove the toxin, and as more is produced its absorption is increased. If the bowel were unobstructed it would be hurried along and the lethal event avoided.

Of the practical value of jejunostomy in obstruction I shall speak later, but the experiments of Wilkie¹⁶ deserve some consideration. He very reasonably criticizes the foregoing experiments because the toxins recovered from the obstructed bowel were injected intravenously. The crucial question is the degree of absorption which takes place in the bowel above the obstruction. In eight animals Wilkie injected into unobstructed bowel the fluid contents from the small intestine of animals dying from obstruction. In

none were any toxæmic symptoms seen within twenty-four hours. Two of the animals, however, developed an acute enteritis. He concludes that damaged or devitalized mucosa is essential for toxic absorption. Stone thus explains the lack of lethal effects in Wilkie's experiments. But Wilkie also failed to produce the lethal effects of pure obstruction even when he introduced the toxic material into bowel above an obstructed loop so that peristalsis could not pass the toxic material along and thus prevent absorption and toxæmia. Wilkie concludes, and I think with reason, that paresis of the jejunum is a most important contributory factor in toxic absorption, and this may exist and persist even when obstruction is successfully relieved by operation. Evacuation of the bowel contents is one important factor in recovery, but restoration of peristalsis is also essential. The jejunum is constructed for absorption, and it is probably right to speak of its area as the "poisonous proteose level" in obstruction.

On the clinical side the obstruction due to an impacted gall-stone is a variety particularly liable to lead to this latent toxæmia, and not infrequently the obstruction is very easily dealt with and yet the patient dies. Presumably fatal absorption takes place because of failure of peristalsis, and the disease would possess an even higher mortality than it has if the impaction occurred in the jejunum rather than the ileum, where such a stone is more commonly arrested.

NEOPLASMS AND CYSTS.

Neoplasms.—A careful perusal of the literature confirms one's personal experience that new growths rarely affect this portion of the intestine. It is certainly not much subjected to the irritation of faecal matter, and since this is commonly regarded as one of the factors in the production of epithelial malignant disease, it is not strange that primary carcinoma of the jejunum should be almost a pathological curiosity. The same is not true of sarcoma, and probably half the intestinal sarcomata arise in the small intestine, affecting jejunum and ileum about equally. Such a tumour has several times been observed as the starting-point of an intussusception of the jejunum. According to Goldstein¹⁷ these growths are usually lymphosarcomata, but spindle- and round-celled tumours are also found, and they may contain melanin. They may form polypoid tumours or be infiltrating in type.

All benign tumours of the small bowel are rare. A pure fibroma of the jejunum, the size of a fist, was removed by Miller in 1915, and this is figured in an article on benign intestinal tumours by King,¹⁸ who reviewed the literature and found that, of the simple tumours of the intestinal tract, myomata were the most common; then came lipomata, adenomata, and fibromata. Out of 119 cases, only 8 concerned the jejunum without question. Tumours of the ileum were at least three times as common.

Cysts.—Apart from the cystic degeneration of tumours, there are two types of cyst which call for our attention in connection with the surgery of the jejunum—cysts of the mesentery, and cysts of the intestine itself.

Mesenteric cysts have been known ever since the sixteenth century, but the number recorded is said not to exceed 300 even up to the present time (Higgins¹⁹). Their etiology is still uncertain, and several classifications have

been attempted. We may at once dismiss those which are parasitic, and the dermoid cysts, leaving us with the so-called 'true' mesenteric cysts, most likely of developmental origin. It was assumed at one time that dilatation of lymphatic spaces was responsible for these cysts; that they were comparable to the single or multiple cysts seen in the necks of young children, to which the name cystic hygroma is applied. I see no reason to abandon this as one of the possible causes, but it is also probable that they may arise from Wolffian remains, or as diverticula from the bowel. A persistent portion of the vitelline duct may at times be responsible. Some of these cysts may be traumatic in origin. As regards the mesentery of the jejunum, it is a rare site for such cysts, and they are undoubtedly most common near the termination of the ileum. A case of exceptional interest was recorded by Makins²⁰ in 1911 of a multilocular cyst in a child of 6, which caused acute obstruction by pressure on a portion of the jejunum. From infancy the child had been subject to attacks of abdominal pain with occasional vomiting. The operation was performed for urgent symptoms of six weeks' duration, and three inches of jejunum were flattened out like a band on the surface of the cyst. The contents consisted of chocolate-coloured fluid in one sac and of colourless fluid in the others. Before operation a large tumour could be felt in the umbilical region. Excision of the cyst with the implicated bowel, and axial anastomosis, were successfully performed. Makins assumed that these cysts were examples of lymphangiectasis, but the wall of his cyst had no endothelial lining, and consisted of fibrous tissue with some non-striped muscle fibres. The presence of these muscle fibres goes some way to suggest an enterogenous origin.

A type of cyst of very great interest and considerable rarity is also met with about the jejunum, but on its antimesenteric aspect rather than along its concave border. I refer to the disease called cystic pneumatosis. An admirable description of this was given by Nitch²¹ in his presidential lecture before the Surgical Section of the Royal Society of Medicine in 1923, and he is responsible for the statement that "the jejunum is frequently involved as well as the ileum, but it is rare to find cysts on this portion of the bowel alone". Only about 90 cases in all have been described, and the etiology of these gaseous cysts is entirely speculative.

INFARCTION OF THE JEJUNUM.

In my researches into the literature I have so far failed to find a case of infarction limited to the jejunum. A consideration of the blood-supply of the bowel would naturally lead one not to expect such a lesion.

CONGENITAL OCCLUSION OF THE JEJUNUM.

In a review of 392 cases of congenital atresia of the intestine, from pylorus to anus, Davis and Poynter²² found that its incidence in the jejunum and ileum was about equal, so that the condition is not specially attributable to errors in development about the vitelline duct or the iliocecal valve. One-third of the cases affected the duodenum. They describe a case of multiple strictures limited to the jejunum in a child forty-eight hours old, which could

be treated only by enterostomy. Death ensued six hours later. The post-mortem revealed no atresia elsewhere. The mesenteric arteries were normal in distribution, but opposite all the atresic portions of bowel the walls of the vessels were sclerosed, and the terminal branches of the arteries were occluded by an overgrowth of cells apparently derived from the endothelium.

ULCER OF THE JEJUNUM.

Any and every variety of ulcer has been found in the jejunum, but that which we are most accustomed to meet with is ulceration following gastro-jejunosomy. This is an example of man-made disease. The question of greatest importance is whether peptic ulcer can occur in the jejunum apart from this short-circuiting operation, which allows gastric juice to come in contact with the jejunum before neutralization has occurred.

This question has been admirably discussed by Richardson²³ in 1922, and Patterson Brown²⁴ in 1924. The former deals only with ulcers of the jejunum; the latter with those which are 'simple' and affect jejunum and ileum. Van Roojen²⁵ in 1909 described 3 cases of what he regarded as peptic ulcer of the jejunum without gastro-enterostomy, and the importance of his observation centres round the word 'peptic'. Richardson recorded two cases of his own. In one the ulcer was only twelve inches below the end of the duodenum; in the other it was located about the middle of the jejunum. He analysed 10 other cases from the diagnostic point of view, and in these 12 examples of ulcer the adjective 'simple' was fully justified: though syphilis could not be absolutely ruled out, for the results of a Wassermann reaction were not recorded, and only one was examined microscopically for the spirochæte of syphilis. Perforation occurred in 10 of these 12 cases. Several of them bore a distinct resemblance to the ulcer commonly met with in the stomach, and in 7 the ulceration was obviously chronic. One was annular, but dysentery, malignant disease, and tuberculosis appear to have played no part in the causation of any of them. Typhoid, uræmia, and simple distention were also excluded. Richardson, however, objects to the term 'peptic' on the ground that we should have to accept the existence of a digestive ulcer in an alkaline medium, and their very rareness makes this theory improbable. In only two of the cases was there coexistent ulceration of the stomach or duodenum. There are again other unclassified ulcers in the rest of the small intestine, so it would appear impossible to be more definite at the present time than to speak of these ulcers as simple, and for the most part chronic. Even in 1924 Patterson Brown was able to collect only 35 cases for both jejunum and ileum, so that we may assume that primary jejunal ulcer remains a very rare disease. It is quite otherwise with jejunal ulcer following gastro-enterostomy, and to this subject some attention must be paid.

Ulceration following Gastrojejunosomy.—This important sequel to an operation, which, to quote Mr. Sherren's²⁶ recent Bradshaw lecture, "has done as much, if not more, for the good of the human race than any surgical procedure", I have already referred to as a man-made disease. It is a most unfortunate blemish on the surgery of the stomach, and I do not think any surgeon of experience can claim that his patients are immune from it. That

it is an artefact of gastric surgery is supported by my argument with regard to simple jejunal ulcer. That special precautions taken whilst doing the anastomosis have reduced its incidence goes further to prove that the surgeon is often responsible. The use of absorbable suture material appears to be the most essential of these precautions, and Mr. Sherren has advised against the use of a clamp on the jejunum, which is a luxury rather than a necessity for the surgeon. It may perhaps be responsible for damage to the wall of the jejunum and thus possess a hidden danger for the patient.

It is usual to speak of gastrojejunal or anastomosis ulcer, and jejunal ulcer proper, but there is no doubt that the anastomosis ulcer is the commoner, and Walton²⁷ would have us believe that even when the ulcer is found in the jejunum it has always spread downwards from the anastomotic line. Sherren does not agree with this; neither do I, for I have operated on a perforating ulcer of the jejunum several inches from the suture line and not connected with it by fibrous tissue. After all, any one surgeon's experience of this lesion is not great, and it is perhaps true that the more gastro-enterostomies he does the fewer post-operative ulcers does he see—or, shall I say, cause.

Nine cases of this lesion have come under my immediate care, and, of these, 6 should be classed as gastrojejunal, 2 as jejunal, and 1 presented a gastro-jejuno-colic fistula. In 5 of them the gastro-enterostomy was performed by myself, and this represents roughly an incidence of 2 per cent. I am in the habit of using clamps on both jejunum and stomach. Up to 1917 I used silk suture-material, and also removed some mucous membrane from the jejunum. This I believe now to be undesirable, and there is something to be said for a separate stitch for the mucosa. Microscopical examination of anastomoses at various periods after the operation has convinced me that the average suture line—and I have sectioned those of several surgeons—is very irregular, and the time of healing must be very variable.

A matter which appears to me of the greatest importance in technique is the treatment of the mucosa. Moynihan²⁸ in 1914 advocated removal of an ellipse of mucous membrane from both stomach and jejunum, and other writers have followed the same lines. The more recent text-books on operative surgery urge economy in the matter of the mucous membrane. The object is to secure an immediate and relatively large opening and avoid a mere slit, but I do not believe this can always be done without running the risk of delayed healing. Better some swelling of the margins of the wound, and temporary blockage of the anastomosis, than failure of mucosal healing and exposure to erosion by acid secretion. How many surgeons realize the importance of the conservation of every bit of mucous membrane it is difficult to know, but Sherren²⁹ is quite clear on the point, and he does not remove any redundant mucous membrane. That of the jejunum always appears to be excessive, but nevertheless I believe it should never be excised. The microscopical section shown in *Fig. 204* came from a case where the gastro-enterostomy was perfectly satisfactory from a clinical point of view, and the patient's death was unconnected with the peritoneal cavity. The suture material used was 00 iodized chromicized catgut, and the specimen was obtained from a post-mortem examination twenty-four hours after death. The anastomosis was performed sixteen days before the specimen was recovered

from the post-mortem room. To the naked eye there appeared to be perfect continuity of surface between stomach and intestine. The microscope, however, shows that there is in reality a mucosal ulcer, and the gap is filled up with fibrous tissue, in the deeper layers of which remains of mucosal cells can be identified. No mucous membrane was excised in this case either from the stomach or the jejunum, but it is evident that necrosis has occurred from the embrace of the suture, and this appears to be inevitable. The only way to diminish this loss of tissue would be to use interrupted stitches; but most surgeons will cling rather tenaciously to the hæmostatic suture; if it is interrupted its hæmostatic value is lost. Exactly how long the process of

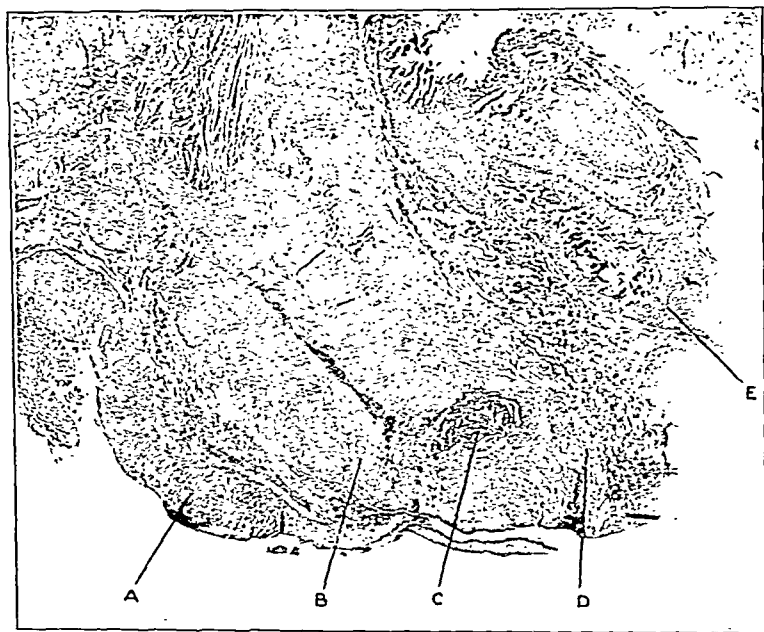


FIG. 204.—Shows pronounced gap in mucosa revealed only by microscopy. To the naked eye the mucosa of stomach and intestine appeared to be continuous. A, Mucosa of jejunum; B, Muscularis of jejunum; C, Unabsorbed catgut; D, Fibrous union of stomach and intestine; E, Mucosa of stomach.

final healing takes is, I think, an unknown quantity, but I should put it down at quite one month, and possibly two. For this reason a careful dietetic régime is rightly insisted upon for at least three months from the date of operation. Fibrous tissue is not proof against the attack of hydrochloric acid.

The two cases which I should classify as true jejunal ulcer in my practice have occurred in patients who started their unfortunate gastric career with a perforation of the jejunum. In both of them an anterior gastro-enterostomy was performed later. In one case the perforation was in the afferent loop, and the anastomosis was drawn out into a tubular connection between the stomach and the jejunum. The other jejunal perforation was a recurrent one, and I cannot say positively that there was no inflammatory thickening

along the line of the anastomosis. This perforation was in the distal limb of the jejunum an inch and a half below the junction with the stomach.

The clinical aspect of gastrojejunal ulcer is a rather difficult one. Not all patients upon whom gastro-enterostomy is performed for a positive lesion are at once converted to the eupeptic state. Some are, and their enthusiasm is very gratifying. Some convalesce slowly, but, nevertheless, they give a perfect end-result. Some resemble "seed sown on stony ground" and they relapse. Sherren, I think, has been a little too sweeping in asserting that a gastro-enterostomy patient who is perfectly happy for two years after the operation never gets trouble again, and does not run the risk of a gastrojejunal ulcer; but the majority of such patients will admit to having experienced periods of discomfort shortly after the operation. Gradually their symptoms acquire the characteristics commonly associated with duodenal ulcer. Hunger-pain is often a prominent feature. The only physical sign in peptic ulcer on purely clinical examination is tenderness on pressure. This, in the case of gastrojejunal ulcer, is placed to the left of the umbilicus and a short distance above it.

Carman³⁰ gives the following points in connection with the diagnosis of gastrojejunal ulcer by means of X rays: (1) Retention from the six-hour meal; (2) Pain on pressure in region of first loop of jejunum behind the anastomosis; (3) Impaired peristalsis; (4) Ampulla-like distention in the region of the anastomosis; (5) Distortion of the stoma and pain on pressure; (6) Narrowing of the efferent limb of the jejunum near the stoma; (7) Dilatation of duodenum or afferent limb of jejunum; (8) A definite pocket retaining the barium is rarely seen. Since the last-mentioned sign is the crucial one in the X-ray diagnosis of any ulcer, it will be readily seen that a positive diagnosis by radiography is by no means easy to obtain. Certainly not all deformities of the jejunum after anastomosis point to an ulcer; but if the clinical signs suggest it, there is usually support for the diagnosis in the X-ray appearances.

JEJUNOSTOMY.

The Value of Jejunostomy.—Jejunostomy is an operation which is comparatively rarely done, but I shall endeavour to show that there are many conditions for which it may be useful, and there are several, I believe, where it is positively indicated. As a place for the reception of food the jejunum is quite satisfactory. Milk, eggs, and sugar poured in by means of a tube and funnel at four-hourly intervals will easily maintain the nourishment of the patient. At first the quantity administered should not exceed 6 oz., but in quite a short time the jejunum becomes accustomed to further distention, and 10-oz. feeds can be given. It appears to make little difference whether the milk is pancreatized or not. Such jejunal feeding is quite well borne after the first few days, and the majority of patients will cheerfully submit to a régime which permits neither fluid nor solid by the mouth provided they are thus rid of their pain. But the use of a jejunal fistula is not limited to the ingestion of food. Jejunal drainage is the key-note to the successful relief of intestinal toxæmia which we have already discussed in dealing with high intestinal obstruction. I shall therefore discuss the value of this operation from the aspects of both ingress and egress to and from the intestinal canal.

Technique of Jejunostomy.—It is clear that a modification of the Witzel gastrostomy, originally suggested by Moynihan, has much to recommend it (*Figs. 205, 206*). It is rapid, it can be done without risk of soiling the peritoneum, and the loop of jejunum selected requires very little anchoring to the parietal peritoneum. If a couple of stitches be used for this purpose at the top of the wound, it is usually quite enough. Perfect security of the tube itself is most important, and a self-retaining winged catheter is best, although it is a little awkward to introduce. If an ordinary catheter is used, it is well to cut off its tip so as to make the opening terminal and not lateral. It is a good plan to encircle the tube with a stitch as it is brought out through the rectus sheath, and also as it lies upon the surface of the skin, for if the tube is

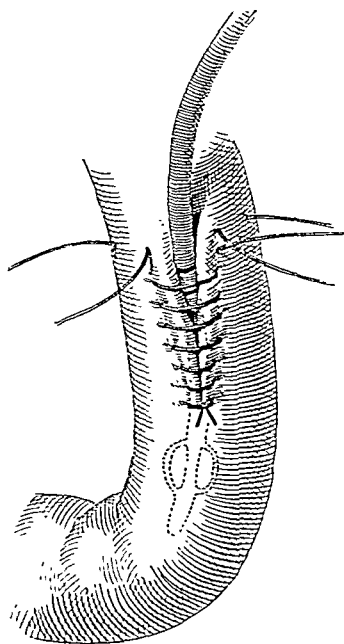


FIG. 205.—Technique of jejunostomy. Catheter within the lumen of the bowel. Note the anchoring peritoneal sutures.



FIG. 206.—Technique of jejunostomy. Skin incision closed and tube anchored to the surface of the skin above.

dislodged during the first few days it will be well-nigh impossible to replace it. This operation can be carried out quite easily under local anæsthesia through the upper fibres of the left rectus, provided each layer is thoroughly infiltrated before division. If speed is essential owing to the poor condition of the patient, jejunostomy may be done through the mid-line, and even simple anchorage of a loop of bowel to the anterior abdominal wall with a catheter tied in will suffice, but there is a danger of leakage when the tube is removed. This hardly ever occurs if the Witzel technique is followed.

Jejunostomy as a Substitute for Gastrostomy.—This is the most obvious indication for jejunostomy. In my experience it is just as efficient as

gastrostomy, and easier to perform without risk of leakage. It is therefore appropriate as a means of feeding in cases of *carcinoma of the œsophagus* where the stomach is small and immobile, as well as in cases of *malignant disease of the stomach* itself that are unsuitable for excision or gastro-enterostomy.

In certain cases of *chronic gastric ulcer* there is a distinct field of usefulness for jejunostomy. It is the only method of continuous feeding whereby the stomach can be given absolute rest and the nutrition of the patient maintained even whilst at work. For this reason it has been recommended for bleeding ulcers of the stomach and duodenum. It is in connection with inoperable ulcers that I have found it most useful. Moynihan³¹ has made use of this method of feeding, and for irremovable ulcer he has advised gastro-enterostomy combined with jejunostomy. The healing of the ulcer, which is always slow, can be watched by X-ray examination, and he records cures at the end of periods from six months to three and three-quarter years. During this time his patients received neither solid nor fluid food by the mouth.

The question arises as to the need for the gastro-enterostomy. Swallowed saliva and gastric secretion of psychological origin are likely to be the only contents that need to be diverted from the pylorus, unless hypersecretion occurs in such cases apart from digestion. My own impression is that all these activities are so reduced that the stomach is actually put out of action, and the value of the gastro-enterostomy has a bearing on the deformity which may result from cicatrization rather than on the actual healing of the ulcer. I have proceeded on this assumption in a series of 6 cases, of which a few details are given here. In all of them the ulcer was close to the cardiac end of the stomach, adherent, and sufficiently large to be regarded as irremovable. In most of them the stomach was immobile and a gastro-enterostomy on the cardiac side of the ulcer a practical impossibility. There was therefore no choice except partial, and not very partial, gastrectomy, and the much less dangerous operation of jejunostomy.

Two of these cases have died since the operation. One died eighteen months afterwards, having been relieved of pain, but never making much progress in health or appearance. The explanation of this was that his ulcer was carcinomatous, a fact which was proved post mortem. The other fatal case was that of a man whose ulcer I suspected of malignancy, but I have no microscopical proof of this. He suffered from glycosuria, and presented a mass near the cardiac end of the stomach, with a large crater adherent to the pancreas. He tired of jejunal feeding after three and a half months, and, because I thought his ulcer malignant, I allowed fluid by the mouth at this time. An X-ray taken before this permission was given showed some spasm of the stomach, but no hold-up of barium. From this time he continued to improve. Six months after the jejunostomy the tube slipped out, and no attempt was made for twenty-four hours to put it back. Then it was impossible. Considerable progress was made after this, and the patient was delighted. for his weight rose from 8 stone at the time of the operation to 12 stone. But cure was not obtained. Nineteen months after the operation he had a sudden and copious hæmorrhage, and death ensued in two days. Two facts are brought out by this case—namely, the falsity of symptoms in the case of gastric ulcer, and the rapidity of closure in a well-formed jejunostomy.

A third case must be regarded as a failure because the patient, a very sensitive woman, declined to continue the jejunal feeding after the fourth month. Her X-ray showed the ulcer lessened in size, and the fistula healed promptly and needed no operation to close the bowel. In her case pain had never been much in evidence, and for this reason she could not appreciate the value of the treatment.

The other three cases are much more satisfactory.

A. C., male. Ten years' history of indigestion, with severe pain, vomiting, and marked emaciation. Hematemesis occurred once in 1921. X-ray examination showed a bilocular stomach with a visible ulcer crater. Jejunostomy was performed in February, 1923. He stuck to the jejunal feeding entirely for ten months, during which time he put on 2 stone in weight. Then he was tempted by cold weather to take milk pudding. This did not interfere with his progress, but a small crater could still be visualized radiographically in December, 1923. About this date the tube slipped out and mouth feeding was resumed entirely. His own expression was that he felt as fit as he ever had done in all his life. His X-ray taken in March, 1924, showed a spasm of the stomach lasting for an hour, but no crater could be seen. The last examination in June, 1925, showed a bilocular stomach, but no ulcer. He was then doing a full day's work of ten hours, weighed 11 stone 3 lb. as against 7 stone 5 lb., and was eating all kinds of food. He has reported that all was well up to November of last year.

J. A., male. History of seven years' duration. Jejunal feeding for four months from June to October, 1923. Persistent shadow visible in X-ray taken in May, 1923. X-ray report in October: "no evidence of ulcer". Consistent progress. Weight in April, 1924, 12 stone 4 lb. On full diet and at work as a seaman. Last X-ray report in April, 1924: "the appearance is that of a normal stomach". No return of symptoms up to date.

R. C., male. Nine months' history. Very severe pain. X-ray showed large extrusion ulcer on lesser curve. Operation revealed a large saddle ulcer with a crater $2\frac{1}{2}$ in. across, adherent both to liver and pancreas. Jejunostomy in February, 1924. Immediate cessation of pain and rapid increase in weight; gained 2 stone in three months during strict jejunal feeding. Confessed to taking a little fluid by the mouth four months after the operation. Only a very little allowed. Steady progress. Returned to work as a railway guard five months after the operation. This he is doing now. He is loath to leave out his jejunostomy plug, and I have not sanctioned this, because the X-ray taken in March, 1925, showed evidence of gas still in the ulcer crater, but no barium was held up in it.

In spite of the fact that these patients all defaulted, and yielded to the temptation of mouth drinking before there was X-ray evidence that the ulcer had healed, the results are encouraging. They were all desperate cases, and my experience confirms Moynihan's suggestion that ulcers not amenable to gastrectomy may nevertheless be treated by jejunostomy. Possibly medical treatment without artificial feeding could show similar results, but it seems a pity that physicians are apt to rely on clinical signs, and do not appear to submit their patients to routine X-ray examination, which alone affords conclusive evidence of cure so long as the abdominal wall stands in the way of inspection of the stomach itself. Even epigastric tenderness is unreliable at times, and it may disappear when the X-ray still shows a hold-up of the opaque meal.

Jejunostomy has a further use in connection with gastric ulcers—namely, as a preliminary to gastrectomy. A poorly nourished patient, worn out with

gastric pain, may be made into a good surgical risk by simple jejunal feeding, and the large operation, which in the first instance could not be tolerated, may be undertaken with every prospect of success.

Walker³² has advocated jejunostomy in the *pernicious vomiting of pregnancy*, and he quotes a successful case, but I think this may be regarded as rather controversial ground.

Jejunostomy in Intestinal Obstruction.—In opening the discussion on acute intestinal obstruction at the meeting of the British Medical Association last year, Sir William Taylor considered the treatment according to the stage of illness in which the patient was first seen. The early stage of obstruction need not concern us unless it involves the jejunum directly. Full exploration is permissible, and it is only necessary to deal with the obstructing lesion laid bare to the surgeon's view. The second stage is characterized by distention of bowel. Here the obstruction should be relieved, but in addition Sir William advises a temporary jejunostomy; it may be needed only for twenty-four or forty-eight hours. In the third stage the condition of the patient will not warrant an abdominal exploration. Relief of distention, and that under local anaesthesia, is all that he would permit—later, the obstructing cause may be dealt with.

With this teaching I am fully in agreement, based as it is on the arguments I have already brought forward concerning proteose poisoning from the contents of the upper reaches of the intestinal canal. Operating on patients in the second stage, I have often been disappointed in my effort to empty the small intestine, and at the same time unpleasantly conscious of the risk of infection of the peritoneum. If this process can be satisfactorily set going by a jejunostomy, it is much quicker and safer. Intestinal lavage can also be instituted, for, in between the periods of drainage, glucose and bicarbonate of soda can be let into the bowel. Toxins may be evacuated and toxins may be diluted. Both processes are of advantage to the patient. With regard to the suggested treatment of the third stage, the grave condition demands that something be done, and jejunostomy can be performed quite well under local anaesthesia; thus one of the greatest risks of operating on such a patient can be avoided.

The question which naturally arises is: Why make an opening in the jejunum? Victor Bonney³³ is credited with being the first to insist on the importance of draining at this high level, and his argument is that it is the jejunum which is waterlogged with toxic fluid, whereas the ileum contains much gas as well as fluid. I am not sure that this observation is universally true, but nevertheless, in view of the higher toxicity of the bowel contents at this level, I believe the treatment is sound. In my own cases I have often found that the jejunum at operation may yield little but gas; in a few hours, however, fluid begins to pour forth in quantity.

The value of intestinal drainage in true paralytic ileus was well shown in a paper which I published in the *Annals of Surgery* in January, 1910. This concerned two cases following fracture of the ribs, and the cause of the paralysis, no doubt, was the irritation of the splanchnic nerves. The first case ended fatally in spite of abdominal exploration, which revealed no obstructing lesion. The second was much relieved by intestinal puncture, and

finally cured by tying a winged catheter into the distended small intestine. This was reached through a small mid-line incision just above the umbilicus, performed under local anæsthesia. It was impossible to identify the portion of the small intestine utilized, and at the time I assumed that it was the ileum. I have no doubt now that this operation was in reality a jejunostomy, and its good effect probably lay in the fact that the opening was high up. Siphonage was used to drain the bowel, and peristalsis was re-established in twenty-four hours. In forty-eight hours the contour of the abdomen was normal and the patient quite comfortable. The faecal fistula continued to discharge for three weeks, but it ultimately healed spontaneously. In this paper I urged the value of ileostomy whatever the primary cause of paralysis, whether peritonitis was present or not. Now I should rather say jejunostomy.

Jejunostomy in Peritonitis.—If we transfer our attention to peritonitis, we shall realize that there may be as much risk to the patient from intestinal toxic absorption as from peritoneal toxæmia, and in many cases it is difficult to be sure by which route the poisons reach the blood-stream. Recent successes claimed for lymphaticostomy would rather point to intestinal absorption as the fatal factor. It is certainly true that fatal cases of peritonitis manifest both true obstruction and paralytic ileus. The former can be caused by bands of very recent formation, not necessarily fibrous, but the mere glueing together and angulation of coils of small intestine. Paralytic ileus means a spread of infection from the serous to the muscular coat of the bowel, or a splanchnic intoxication.

This subject has received considerable attention from Sampson Handley,³⁴ and 'ileus duplex' formed the subject of his Hunterian Lecture in March, 1915. This name he applies to a paralysis of the bowel below the level of the pelvic brim, that is, the lower coils of the ileum and the terminal portion of the colon. The method of treatment which Handley recommends is a short-circuiting of the ileum, with drainage of the large bowel by means of a cæcostomy. In effect this amounts to internal drainage of the small intestine as contrasted with external drainage. Handley advises an ileocolostomy as a preventive measure, and jejunostomy may be similarly employed. The latter is obviously quicker except that it requires a fresh incision, and time and experience alone can show which gives the better results. My own view is that jejunostomy is worthy of a trial as a curative measure if done early. The short-circuiting operation with drainage of the cæcum seems to me rather a severe tax on a patient whose condition is desperate. It would seem likely that the wise plan would be to employ Handley's treatment where prevention is demanded, and external drainage in those cases where the condition is clearly established. My personal experience is limited to the latter operation, and I must admit disappointments. However, one is often called in too late, and I do not regret not having done the anastomosing operation. Fortunately the number of cases where either is required seems to be on the decrease, and for this I think we have chiefly to thank the practice of early operation for appendicitis.

Closure of a Jejunostomy.—If the jejunostomy is done by the Witzel technique trouble rarely arises. If it is carried out in a more primitive fashion—and time and circumstances may sometimes demand this—it is well to

bring the tube out through a portion of the omentum, so that this may plug the opening when the tube is withdrawn. In this way a fistula may be avoided and the patient saved a further operation for its closure when the danger stage has passed.

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PRE-AURICULAR FISTULÆ.

BY F. A. R. STAMMERS, BIRMINGHAM.

THE object of this paper is to record six cases of pre-auricular fistula which illustrate well the familial and hereditary features of this condition, and exhibit one of the complications they may undergo. The literature is briefly reviewed, and the theories of their development are discussed. The two cases suffering complication were admitted to the General Hospital, Birmingham, under Mr. H. H. Sampson, and I am indebted to him for permission to publish them now.

Case 1.—W. B., age 13, a schoolboy in good general health, came up complaining of an ulcer, the size of a sixpence, situated just in front of the left ear. In the crus heliis of each ear was a tiny hole which was the opening of a short fistula, running downwards and forwards for about $\frac{1}{2}$ in. A fine bristle could be passed down each, the one on the left emerging through the floor of the ulcer. The fistulæ were subcutaneous.

HISTORY.—Ever since he could remember he had had a tiny hole in the root of each helix. Just in front of the one on the left side he had also noticed a lump about as large as a split pea. Eight years ago this lump became larger and a discharge was noticed through the tiny hole. The skin over the lump ulcerated, and a scab formed, from beneath which a sticky yellowish discharge has exuded intermittently ever since. He has been treated by various doctors with lotions and fomentations, but always without success.

Mr. H. H. Sampson dealt with the case by excising the fistula and its suppurating area, and the procedure has been completely satisfactory. The boy says that the fistula on the right side has never discharged, but a bead of seropurulent fluid can always be squeezed out.

The serial sections kindly carried out by Dr. F. M. W. Lamb show: "Septic granulation tissue which is in direct communication with a sinus lined by squamous epithelium." Apart from a small pigmented mole on the left side of the face, there is no other abnormality present in this patient.

Case 2.—C. A., age 13, a school-girl in good general health, came to hospital complaining of a discharging ulcer in front of the left ear. Her history was that she had always had a tiny hole in the crus heliis of either side, and from time to time she had noticed a little serous discharge from either fistula. A year ago the one on the left side seemed to become blocked up, and a small lump appeared just in front and below the hole. This became larger, and the overlying skin soon broke down and a scab appeared. Sero-pus constantly exuded from beneath this, and fomentations and lotions had failed to remedy the condition. On examination, a fine bristle could be passed through the holes downwards and forwards subcutaneously for about $\frac{1}{2}$ in., the one on the left side emerging through the ulcerating area.

Mr. H. H. Sampson excised the fistula and ulcer with complete success.

Dr. F. M. W. Lamb reports as follows: "The tissue exhibits a cystic space lined by squamous epithelium and containing a substance like mucus. In one part of the section is a nodule of cartilage." This nodule may be a piece of the spina heliis, or a piece of isolated cartilage in an abnormal position, giving support to the embryological explanation favoured in this article.

Each of these two cases has an interesting family history. In *Case 1* the mother, the maternal grandfather, and the son of the mother's sister have all uncomplicated pre-auricular fistulae, either bilateral or unilateral. The direction of the track in each case is downwards and forwards, and the opening of the fistula is in the crus helieis. It is said that at the age of 18 the grandfather had an ulcer in front of one ear, but that this cleared up without surgical treatment. The mother has it on the right side only and no discharge can be squeezed out, though a bristle can be passed down the track. The cousin has it on the left side only; a bristle can be passed down a distance of $\frac{1}{2}$ in., and a bead of sero-pus can be squeezed out.

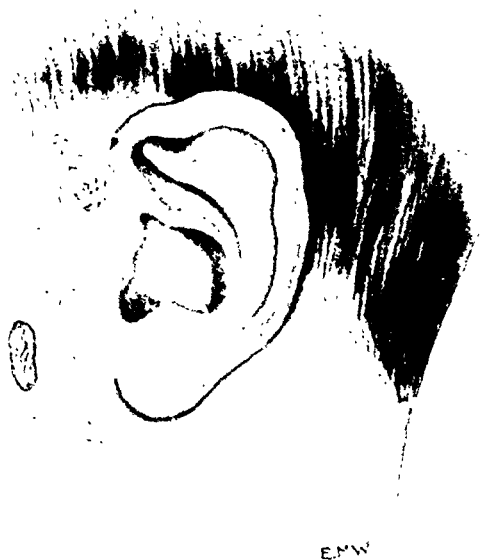


FIG. 207.—*Case 1*. Pre-auricular fistula in left crus helieis, with ulcer below. At the level of the lobule is a pigmented mole.

In *Case 2* a cousin only is affected, but in her case a mere dimple is present: this is in the crus helieis. No bristle can be passed, and no sero-pus appears on pressing the area in front.

The illustration (*Fig. 207*) shows the condition before operation in *Case 1*. The position of the fistula in the various relatives was identical.

Literature.—Very little notice seems to have been taken of this congenital deformity, and this is hardly to be wondered at in view of the negligible disfigurement and absence of symptoms where no complication ensues. However, when an ulcer develops in front of the ear due to blocking of this little sinus, the presence of which remains unrecognized, and palliative treatment meets with no success, it would seem worth calling attention to this congenital deformity as a possible cause of

Text-books refer to the condition in the scantiest of terms. In 1910 Howell Evans¹ wrote a paper on "Auricular and Peri-auricular Dermoids, Fistulæ, and Tumours of Congenital Origin". He states that these fistulæ are most commonly found "in the region of junction of tragus with crus helcis, of crus helcis with helix, and between antihelix and helix". The six cases reported in this paper belong to the second of these three sites. He also says that these fistulæ tend to run downwards and forwards.

It was Sir James Paget² who, in this country, first called attention to these fistulæ in 1878.

In 1909 Sir Arthur Keith³ gave three demonstrations at the Royal College of Surgeons on congenital malformations of the palate, face, and neck, and stated that there was a close relationship between accessory auricular appendages and pre-auricular fistulæ. He also noted the association of these deformities with other anomalies, such as cleft palate, spina bifida, or imperforate anus. In none of our cases were there any other accompanying aberrations.

Fournier,⁴ working in Moure's Clinic, published in 1919 a more complicated type of pre-auricular fistula. This, as in ours, commenced in the crus helcis, but passed downwards through the parotid gland, and opened again on to the surface of the neck just below the angle of the jaw. Moure treated this successfully by excision.

Pritchard, Paget, and Rugani all published cases exhibiting the familial feature of these fistulæ—several cases occurring in each of several families.

With regard to the rarity of the condition, figures seem to vary. Eyle⁵ gave 0.26 per cent, and Bezold and Urbantschitsch⁶ 0.19 per cent, of the cases coming up to them for examination. Rugani⁷ would put it at a much higher figure. I have looked at the ears of some 500 in-patients, and have not seen any case of pre-auricular fistula.

Origin.—Most observers appeal to some developmental error as an explanation of these fistulæ. It may be said that three theories exist: (1) That such a fistula is the remains of the first branchial cleft. (2) That it is due to failure of union between some two of the six tubercles which appear around the posterior end of the first cleft and which go to form the pinna; or some anomalous process occurring in connection with these tubercles. (3) Failure of union of the soft parts corresponding to and overlying the posterior ends of the mandibular and maxillary processes of the first arch. The majority of text-books still favour the first of these three theories, as did authorities like Schwartz, Virchow, and Urbantschitsch. Others, such as His, Gradenigo, and Rugani, state that there is no connection whatsoever between these fistulæ and the first cleft. I have discussed the problem with Dr. Brash, Professor of Anatomy of the University of Birmingham, and he too thinks there can be no connection between the two, and favours the second theory. I would here express my gratitude to Professor Brash for his views on the subject, and references to the literature he has given me.

To make the matter clearer I will briefly describe the development of the external ear and include two of His's diagrams (*Figs. 208, 209*).

The external auditory meatus and concha are developed from the first branchial cleft. Around the posterior end of this cleft six tubercles appear.

Two are on the first arch, three on the second arch, and the remaining one appears at the junction of the first and second, namely, at the posterior end of the cleft. Each one of these six tubercles is destined to form a definite part of the pinna. For convenience of description they are numbered 1 to 6

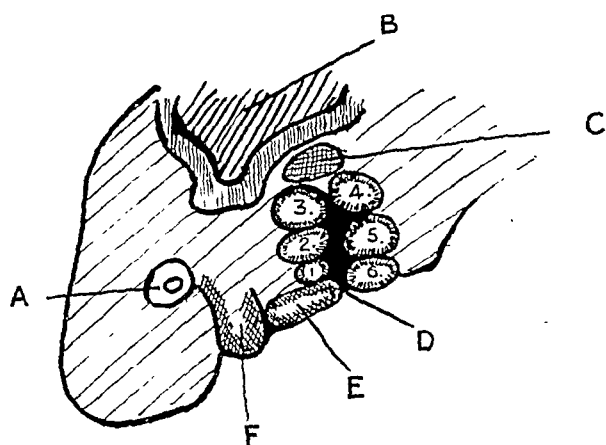


FIG. 208.—Diagram showing : A, Eye ; B, Brain ; C, Otic vesicle ; D, First cleft ; E, Mandibular arch ; F, Maxillary process.

from before backwards, as shown in the diagrams—No. 3 being the one situated at the posterior end of the first cleft. It will therefore be seen that the posterior end of the first cleft, i.e., that part which goes to form the external auditory meatus, lies between 1 and 2 in front, and 4, 5, and 6 behind, and therefore any vestigial remains of this cleft would lie in a corresponding position. Now, 1 and 2 form the tragus and crus helicis respectively, and 4, 5, and 6 form the antihelix, antitragus, and lobule respectively (His). No. 3 forms the helix. So it will be seen that any deformity resulting from remains of the first cleft will lie between the tragus in front and lobule behind, and will, moreover, communicate with the concha and external auditory meatus. Pre-auricular fistulæ do not lie in this position, nor do they communicate with the external auditory meatus.

On the contrary, it is easy to imagine a little subcutaneous track being formed during the coalescence of these six tubercles. The fistulæ of this series of cases were developed in the area of coalescence of 1 and 2. Observations show that the commonest sites are in the crus helicis and between this and the tragus. The downward and forward direction of the fistulæ is explained by the downward and forward development of the mandibular arch with its maxillary process.

Yet a third theory is advanced by some authorities; this is that such fistulæ are the posterior end of a macrostoma. They hold that though the anterior end is normal, so that no actual macrostoma is present, the soft parts overlying the posterior end of the mandibular bar and its maxillary process have just failed to unite. the direction of these fistulæ; but a macrostoma, even in its severest form, never extends quite so far back as the ear.

This theory explains

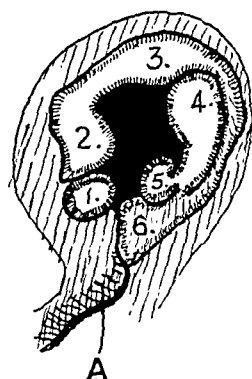


FIG. 209.—Diagram showing : A, Mandible ; 1, Tragus ; 2, Crus helicis ; 3, Helix ; 4, Antihelix ; 5, Antitragus ; 6, Lobule.

SUMMARY.

1. Six cases of pre-auricular fistulæ are reported. They are all situated in the root of the helix. The six cases came from two different families.

2. Two of these fistulæ had undergone occlusion of the opening with subsequent suppuration.

3. These fistulæ are not remnants of the first branchial cleft, but result from aberrant coalescence of the six tubercles which are destined to form the pinna.

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⁵ EYLE, BEZOLD, VIRCHOW, *HIS*, quoted by FOURNIER.
⁶ URBANTSCHITSCH, *Wien. Monats. f. Ohrenheilk.* 1877.
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SHORT NOTES OF RARE OR OBSCURE CASES.

FRACTURE OF THE FIBULA WITHOUT SYMPTOMS.

BY SYDNEY SMITH, CAIRO.

A YOUNG man of 25 years was sent for examination in order to ascertain whether certain marks on his leg had been produced by a firearm projectile, or whether he was attempting to fabricate a case. The injury occurred twenty-three days before examination.

He had a wound on the inner side of the left leg about 1.5 cm. in dia-

meter, and a similar wound on the outer side of the same leg at a lower level. From an examination of the wounds and clothing there was no doubt that he had been shot, and an X-ray photograph was taken to ascertain whether there was another slug in the tissues, for the wounds suggested a fairly rough slug, or slug fired from a shot-gun, rather than a revolver bullet. The skiagram (*Fig. 210*) showed a comminuted fracture of the fibula of considerable extent.

This man had been walking about for twenty-three days, had climbed up two flights of stairs to my office, sat down and rose up repeatedly during the reconstruction of the crime, and yet made no complaint of pain and showed no sign of disability whatsoever.

Although it is quite well known that the fibula plays a very minor part in the support of

the leg, I do not think that anyone would have suspected that such an extensive comminuted fracture could have taken place without symptoms. Another point of interest is the very small amount of callus produced during the period.

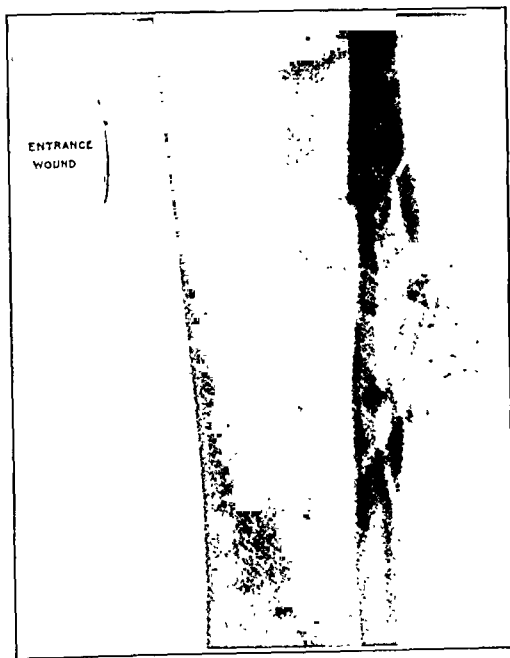


FIG. 210.—Fracture of the fibula without symptoms.

A CASE OF CERVICAL DISLOCATION AND PARAPLEGIA WITH RECOVERY.

By G. L. ALEXANDER AND HERBERT J. SEDDON, LONDON.

IN November, 1924, W. C., age 16, was treated at St. Bartholomew's Hospital for multiple infective arthritis. On one occasion he complained of slight stiffness in the neck. He remained in hospital for six months, and continued to attend as an out-patient.

In March and April, 1926, he again complained of stiffness in the neck, but no abnormality was noted until May 28, when a protuberance in the mid-line of the neck behind, with a depression above, was observed. A skiagram (*Fig. 211*) showed that there had been a forward dislocation of the atlas on the axis, with probably a fracture of the odontoid process, but the latter was not visible. No symptoms or signs of compression of the spinal cord were present. Careful inquiry failed to elicit any history of injury other than: (1) A severe blow in the mouth with a cricket bat at the age of 10: the boy states that his neck has been stiff ever since. (2) On coming round from the anæsthetic after the removal of several teeth, he found his head hanging over the end of the table (Jan. 27, 1925).

In view of these facts it was considered that dislocation had been present for some time. Accordingly, a plaster cast was taken for the preparation of a suitable support. In the meantime the patient was sent home (May 28, 1926). On June 1 he noticed some weakness of the left arm. On June 7 the left arm was completely paralysed, and the right weak. On the 8th the lower limbs were paralysed. There was no dyspnoea. On the 10th he was brought to hospital and admitted.

ON ADMISSION.—Patient was a pale, thin, undersized boy.

Nervous System.—Ptosis of the left upper eyelid; left pupil smaller than right. Other cranial nerves normal. There was flaccid paralysis of both arms except for slight power of pronation and supination on the right side. Intercostals and diaphragm were acting feebly. Both lower limbs were spastic. All active movements were present in the right, and absent in the left except for slight flexion at the hip.

Reflexes: Arms and abdomen absent; knee-jerks exaggerated; right patellar clonus; no ankle-clonus; plantar responses extensor. Sensations



FIG. 211.—Skiagram showing dislocation of the atlas on the axis.

of light touch, heat and cold were lost below the area of supply of C₂ on both sides. Painful stimuli were appreciated but not localized.

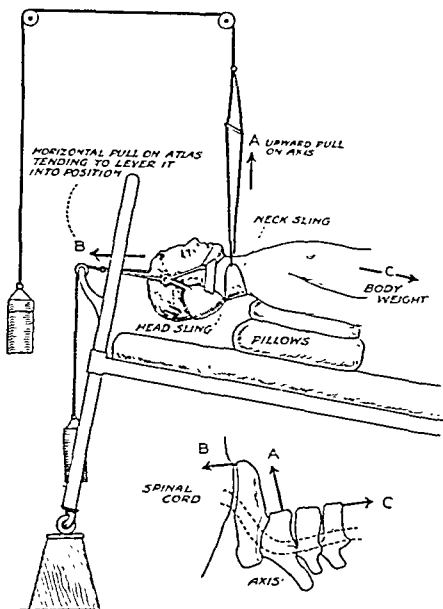


FIG. 212.—Diagram showing the apparatus used in treatment.

long duration of the lesion. (2) Laminectomy—useless, as the body of the axis, and not its laminae, was pressing on the cord. (3) Weight extension to the head. This was adopted, as shown in the diagram (Fig. 212), which will explain more than a wordy description of the apparatus. The patient found considerable difficulty in swallowing uphill, but gradually became used to his new position.

After twelve hours the diaphragm was working feebly, intercostals were working well. No dyspnoea. All movements had returned in right lower and left upper limbs. Plantar reflexes extensor. Urine was passed naturally. After thirty-six hours there was well-marked return of power in the left upper limb; but a persistent wrist-drop made it necessary to retain the arm on a cock-up splint.

June 13: Knee- and ankle-jerks were equal and less brisk. No clonus. Plantar responses flexor. Abdominal reflexes present except in left hypogastrum. Sensations normal.

There was retention of urine; catheterization appeared to evoke a 'mass reflex' of the lower limbs. There was no dysphagia, alteration in voice, or dyspnoea. The spinous process of the axis was very prominent, and a marked depression existed above.

The boy was put to bed with his head between sandbags. Twenty-four hours later he complained of severe pain in the neck and difficulty in breathing. No action of the diaphragm or the intercostals could be detected, respiration seeming to depend entirely upon the accessory and extraordinary muscles; each respiratory movement was accompanied by flexion of both the hips.

There were three possible lines of treatment: (1) Reduction of the dislocation under an anaesthetic—not advisable on account of the supposed



FIG. 213.—Skiagram showing the result of treatment.

June 14: Counter-extension applied.

June 19: Cock-up splint removed from left arm. No wrist-drop. Swelling in neck smaller.

June 25: X-ray in ward showed dislocation reduced (*Fig. 213*).

At the time of writing the only physical signs are: ptosis of left upper eyelid and constriction of pupil; reflexes brisker on the left side than on the right.

This case owes its interest to:—

1. Its rarity as an isolated lesion.

2. Its obscure etiology. There being no definite history of injury suggests that the dislocation must be pathological, due to cervical caries. Points in support of this are: (*a*) The remote history of injury determining possibly the onset of the disease; (*b*) The chronic recurring attacks of cervical pain; (*c*) The relatively gradual onset of the dislocation and its gradual reduction; (*d*) The apparent destruction of the odontoid process.

Against the diagnosis is the lack of X-ray evidence of caries other than the absence of the odontoid. A pathological process sufficient to destroy the odontoid would almost certainly involve other parts of the vertebræ.

3. The completeness and rapidity of the recovery from such an extensive paralysis.

Our thanks are due to Dr. H. Morley Fletcher for permission to publish the notes of this case.

A CASE OF SPLENIC ANÆMIA, ILLUSTRATING A RARE AND FATAL COMPLICATION OF SPLENECTOMY.

By G. F. WALKER, LEEDS.

S. G. R., age 23, was admitted to the General Infirmary at Leeds, and was jointly under the care of Dr. Maxwell Telling and Mr. J. F. Dobson, to whom I am indebted for permission to record the case. The object of this record is to describe an unusual mode of death in splenic anæmia.

The patient stated that he had had no previous illnesses of importance, but complained of three days' abdominal pain, mostly colic, in the left lower quadrant, together with abdominal aching and distention, vomiting, and one brisk hæmatemesis. He was found to have a little free fluid in the abdomen. This increased rather rapidly and then subsided slightly, revealing a peculiar tumour in the left upper quadrant. The tumour was identified as splenic, the organ having an unusually big notch. A blood-count showed: red cells, 3,110,000; hæmoglobin, 30 per cent; colour index, 0.49; leucocytes, 3700.

A diagnosis of splenic anæmia was made, and after preparation the abdomen was opened. At laparotomy several exceedingly large veins were met with in the neighbourhood of the umbilicus. This was the first indication

of the unusually great strain on the collateral circulation between the portal and systemic systems. A further indication of this strain was the discovery that the spleen could not be delivered into the wound because of an extensive plexus of very large veins passing from the posterior abdominal wall to the spleen.

At this point the question of closing the abdomen was considered. It was decided to proceed with the operation. The ubiquitous veins in the ligaments and capsule of the spleen were divided one by one. The pedicle of the spleen, the vessels of which were greatly distended, was secured. The spleen was removed, and the patient did not lose much blood except that contained in the greatly enlarged organ. A few hours after the closure of the abdomen the patient's condition became very bad. He rallied a little, but suddenly had a huge hæmatemesis and fell back dead.

At the post-mortem examination the operation site was found to be perfectly dry and secure. The cause of the hæmatemesis was rupture of an œsophageal vein. The stomach was filled with blood-clot. There was an extravasation of blood into the mediastinum and left pleural cavity from the same source. The liver showed moderate cirrhotic changes.

The accompanying picture (Fig. 214) was made shortly after death. It shows the greatly distended veins in the œsophagus. By the closure during splenectomy



FIG. 214.—Oesophagus with distended veins.

of many communications between the portal and systemic channels the pressure had been raised in these veins even beyond their capacity.

Although in every similar case of splenectomy the pressure in the collateral circulation must be seriously modified and subject in places to sudden increases, yet I am unable to find on record a case where such sudden increase led to a demonstrable rupture in the œsophageal veins with immediately fatal consequences.

ANEURYSM OF THE ABDOMINAL AORTA : DIAGNOSIS BY A LATERAL RADIOGRAPH OF THE SPINE.

BY JAMES F. BRAILSFORD, BIRMINGHAM.

THE following case is of interest chiefly on account of the fact that, in spite of severe pain and other characteristic symptoms which had been present for two years, whilst radiographs were taken on no fewer than four occasions, the nature of the disease remained undiagnosed until a lateral view of the spine was taken.

HISTORY.—T. P., age 47 years. In 1899 he had a venereal sore on the penis, but this was only treated with ointment. He was in the Army from 1898 to 1906, and then rejoined for the whole duration of the War, and was wounded three times. He married in 1910, and had six healthy children. His wife had no miscarriages. In September, 1923, he had pain in the middle of the back at the level of the belt. It was of a gnawing character, with occasional sharp stabs. In April, 1924, he was X-rayed with negative results, and a diagnosis of lumbago was made. In September, 1924, he was again X-rayed, and a slight osteoarthritis of the spine was deduced from the antero-posterior view.

In January, 1925, he began to suffer from palpitation, and on one occasion about this time he had such severe abdominal pains that he fainted. X rays again showed nothing fresh except some enlargement of the heart. The radiological examination was repeated shortly afterwards, but the report was given that the spine showed nothing except some arthritis. He was advised to work as much as possible, and not to lie up, lest he should become a chronic invalid. In the summer of 1925 he noticed a lump on the left side of the abdomen which was at first regarded as a displaced left kidney. For this condition he was referred to Mr. Billington, who sent him to me for X-ray examination.

ON EXAMINATION.—Oct. 15, 1925 : Patient was intelligent and fairly well nourished. Complained of pain in his back, worse on the right side than on the left, and sometimes shooting down to the front of the thigh. He also had dyspnoea and palpitation on exertion. The abdomen showed a slightly movable tumour about the size of the left kidney below the costal margin. Posteriorly, on the same level as this swelling, some pulsation could be felt,

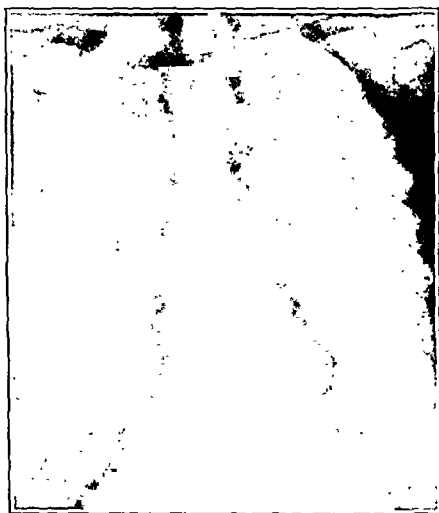


FIG. 215.—Radiograph showing the elevation of the heart shadow.

but there were no sounds on auscultation. The veins in the left lower abdomen and upper thigh were large and prominent. Pulse varied from 100 to 124; regular and of good volume; vessels not hard or thick. Apex beat of the heart $\frac{1}{2}$ in. left of the mid-clavicular line, impulse forcible, no thrill or bruit. Wassermann reaction positive. Marked hyperæsthesia on left side over the area supplied by the 9th dorsal nerve. Impairment of sensation on the left over the area supplied by the 12th dorsal and 1st and 2nd lumbar. Left abdominal reflexes absent.

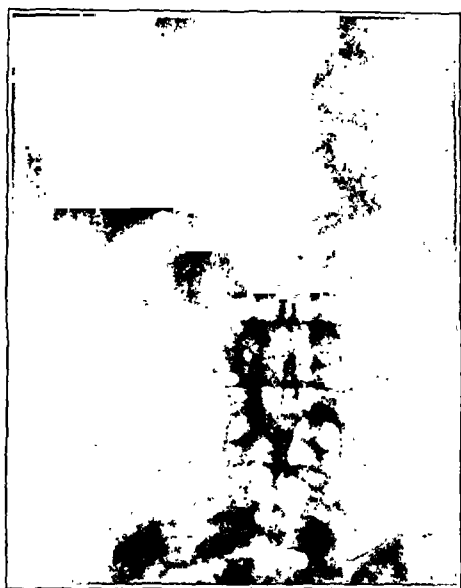


FIG. 216.—Antero-posterior view of spine, showing slight scoliosis.

A radiograph (*Fig. 215*) shows more clearly than the screen the elevation of the heart shadow, which appears to be resting on a body of a little larger size and situated centrally. The thoracic aorta appears to be dilated: this I believe to be a projection effect, as it appeared normal on the screen when the patient was rotated. The lung field appears normal.

Fig. 216 is an antero-posterior radiograph showing a slight scoliosis with its convexity towards the right side at the level of the 12th dorsal and 1st lumbar vertebræ. The left borders of the 12th dorsal and 1st and 2nd lumbar bodies are not so well defined as the borders of the other lumbar vertebræ except at the level of the intervertebral discs. There is some definite bone bridging of the discs between the 11th and 12th dorsal and the 1st lumbar vertebræ on the right side. The left 12th rib is eroded completely through near to the spine, and the head and neck appear to be absorbed.

Fig. 217, a lateral radiograph of the lower dorsal and upper lumbar spine, shows the characteristic 'scolloping' of the 12th dorsal and 1st, 2nd, and 3rd lumbar vertebræ. The intervertebral spacing is not altered. With the production of this radiograph I unhesitatingly diagnosed an aneurysm of the abdominal aorta.



FIG. 217.—Lateral view of lower dorsal and upper lumbar spine, showing 'scolloping' of the vertebræ.

PROGRESS OF THE CASE.—Patient was kept in bed, but continued to

suffer severe pain, with some extension of the area of analgesia. There was no special treatment except by morphia. On several occasions he had severe exacerbations of the pain, which made him faint. On Nov. 29, 1925, he sat up in bed, lit a cigarette, and suddenly fell back dead.

AUTOPSY.—The left side of the chest was full of blood, which had entered it through a rupture of the left dome of the diaphragm. The abdominal aorta presented an aneurysm on its posterior lateral border on the left side at the level of the celiac axis. The sac had partly ruptured into the sheath of the left psoas muscle. The medial walls of the sac as it lay on each side of the vertebral column were formed by the vertebræ and the intervertebral discs, the bodies of the vertebræ being eroded, leaving the discs almost unaffected. The sac was very thin where it lay against the diaphragm, and at this spot the fatal rupture had occurred.

Fig. 218 shows the aneurysm dissected. A window has been cut in the anterior wall on the left side to show the eroded vertebræ. It will be seen that the anterior aspect of the aorta appears to be normal in size.

The patient was shown at a meeting of the Midland Medical Society early in November, 1925, and the specimen illustrated in the photograph at the same Society in December.

I am indebted to Professor W. Billington for his kindness in permitting me to publish the details of this case.

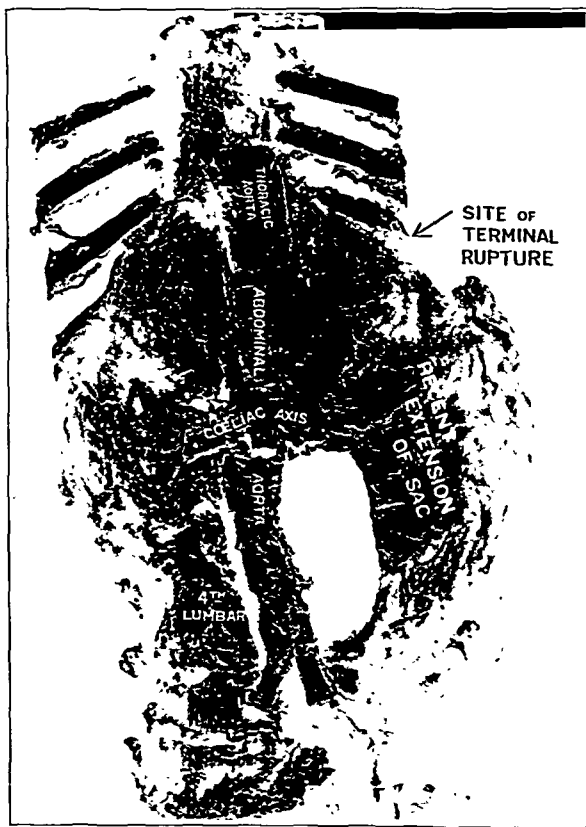


FIG. 218.—Dissection of the aneurysm.

PAPILLOMA OF THE RENAL PELVIS DIAGNOSED BY PYELOGRAPHY.*

By GEOFFREY KEYNES, LONDON.

VILLOUS papilloma of the renal pelvis is to be reckoned among the rarer lesions of the kidney, and very seldom has the diagnosis been arrived at before operation, the kidney having usually been removed on account of a unilateral hæmaturia and the lesion found afterwards. With the more frequent employment of pyelography as a means of investigation, it is probable that the number of instances in which pelvic papilloma has been diagnosed

before operation will multiply; one such case has, indeed, been reported recently by Sir John Thomson-Walker.¹ Meanwhile it seems worth while to record the following in detail.

The patient, a carpenter, age 44, had an attack of hæmaturia in December, 1924, the bleeding being accompanied by renal and ureteric colic. After the pain had passed off the bleeding ceased, and no further symptoms were complained of for nearly a year. Then, in November, 1925, the patient experienced an aching pain across the back in the lumbar region, and this was accompanied by persistent hæmaturia. There was no increase in frequency of micturition. Five weeks after the return of the bleeding he was admitted to St. Bartholomew's Hospital. The urine then contained a large amount of blood, but no pus, and the man looked anæmic. Cystoscopy showed

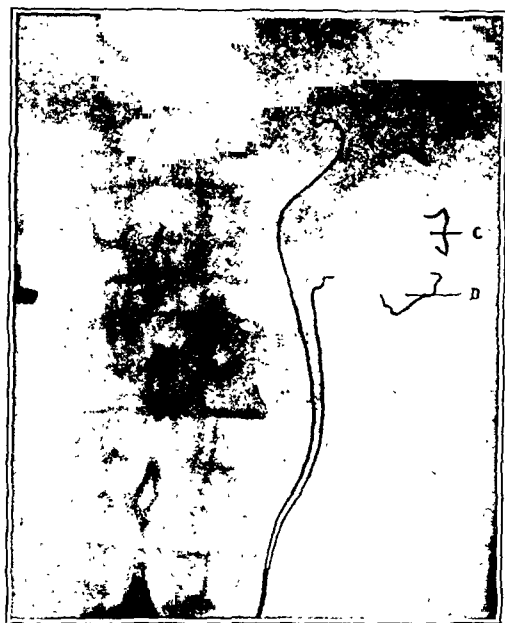


FIG. 219.—Pyelogram, somewhat reduced, showing a filling deficiency in the pelvis, though the calices are filled. The calices are lettered to correspond to the letters on the drawing of the specimen, Fig. 220.

a normal bladder with a blood-stained efflux of urine from the right ureter. Pyelography was undertaken two days later, and 30 c.c. of 15 per cent sodium bromide solution were injected into the right pelvis without causing the patient any pain. The X-ray photograph showed an appearance which justified a definite diagnosis of papilloma of the pelvis. The inner half of

* From the Surgical Professorial Unit, St. Bartholomew's Hospital, by permission of Professor G. E. Gask.

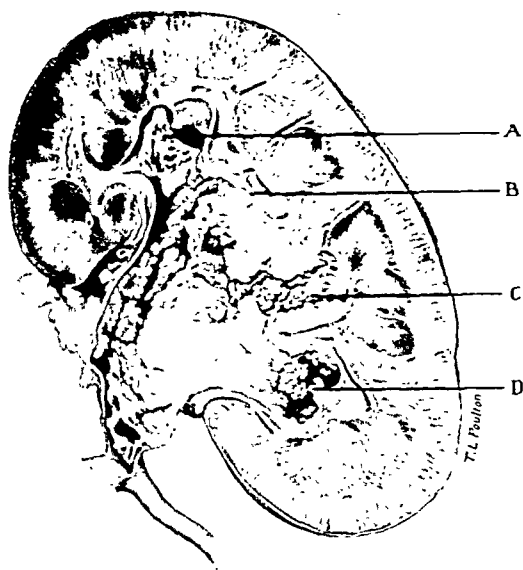


FIG. 220.—Mesial section through the kidney, showing a diffuse papilloma of the pelvis. The main mass of the growth corresponds to the filling deficiency in the pyelogram opposite the lower two calices. The letters correspond to those in Fig. 219.



FIG. 221.—Section through part of the growth, including its base. The normal wall of the pelvis is seen on the left. There is no infiltration. ($\times 15$.)

a dilated pelvis was clearly outlined, and all the calices could be seen at the periphery. Between pelvis and calices, however, was a large irregular filling deficiency. The accompanying reproduction of the photograph (*Fig. 219*) is less convincing than the original film, and it has been necessary to outline the denser parts of the shadow in order to demonstrate the deficiency. Clearly no part of the pelvis had been completely obliterated, as by a hypernephroma or carcinoma, since all the calices had been normally filled, and there was no destruction of kidney substance as by an open tuberculous lesion.

The kidney was removed on March 9, 1926, and the condition was found to be as shown in the drawing (*Fig. 220*). The pelvis was partially filled by a diffuse villous growth, the main mass corresponding exactly to the filling deficiency seen in the skiagram. Sections showed the usual structure of a papilloma, and one from the base (*Fig. 221*) demonstrated that it was histologically innocent, no infiltration being found.

One half of the specimen is in the museum of St. Bartholomew's Hospital; the other is at the Royal College of Surgeons.

REFERENCE.

- ¹ THOMSON-WALKER, SIR J., *Proc. Roy. Soc. Med. (Urol. Sect.)*, 1926, March, xix, No. 5.

OSSIFYING HÆMATOMA OF THE FEMUR, FOLLOWING CONTUSION.

BY JAMES RIDDEL AND W. CHEYNE WILSON, PLYMOUTH.

SIX weeks before admission to hospital, a young man, age 19 years, sustained a severe blow on the front of the right thigh whilst playing football. He continued to play to the end of the game, but during the ensuing few days considerable swelling of the thigh was noticed. As it failed to disperse, and as it interfered with function, advice was sought.

ON EXAMINATION.—A tumour occupied the antero-lateral aspect of the upper part of the right thigh. Fusiform in outline, about the size of a coconut, it lost its definition gradually in the surrounding tissues. Contrary to expectation it was bony hard.

A radiogram (*Fig. 222*), taken by one of us (W. C. W.), disclosed a tumour undergoing ossification which, from the history and the radiological features, was recognized as an ossifying hæmatoma of the upper end of the shaft of the femur.

OPERATION.—The tumour was approached through the fascia lata, and was found to lie deep to the periosteum of the femur. The walls were half an inch thick and composed of cancellous bony tissue. A central cavity was filled with organizing blood-clot. The tumour was removed except for bony spicules which remained adherent to the periosteum.

Subsequent radiograms showed that ossification was still proceeding in slight degree, as would be expected, but function had been restored and the thigh had resumed its natural form.

Comments.—An ossifying hæmatoma may be mistaken for a sarcoma. The lesion is the result of hæmorrhage beneath the periosteum following traumatism. In children, the condition is commonly associated with scurvy.



FIG. 222.—Ossifying hæmatoma of femur.

The periosteum in children, being but loosely attached to the shaft, is the more easily stripped from epiphysis to epiphysis. In adults, ossifying hæmatoma is less frequent. The periosteum is more firmly attached, and hæmorrhage is, in consequence, less extensive as a result of traumatism, and tends to be more localized.

Baetjer and Waters¹ describe 17 cases in adults; 16 followed injuries at football and 1 followed the kick of a mule. They all occurred on the

anterior surface of the femur. In nearly half of the cases a clinical diagnosis of sarcoma was made. They stress the following points in differential diagnosis : (1) In hæmatoma there is a definite sharp calcium border, since hæmorrhage is limited by the periosteum. (2) There is no involvement of bone, and the calcium salts are laid down roughly parallel to the shaft. (3) In malignant bone tumours there are no sharp borders, the calcium salts are laid down more or less perpendicular to the shaft, and the bone is frequently involved.

REFERENCE.

- ¹ BAETJER, FREDERICK H., and WATERS, CHARLES A., *Injuries and Diseases of the Bones and Joints* (1921, Lewis), 277.

REVIEWS AND NOTICES OF BOOKS.

Manual of Surgery. By the late ALEXIS THOMSON, M.D., F.R.C.S. Ed. and Eng., Professor of Surgery, University of Edinburgh; and ALEXANDER MILES, M.D., LL.D., F.R.C.S. Ed., Consulting Surgeon, Edinburgh Royal Infirmary. Seventh edition. Crown 8vo. Vol. I, pp. 565 + xiv, with 169 illustrations; Vol. II, pp. 663 + xvi, with 299 illustrations. 1926. London: Humphrey Milford. Each 12s. 6d. net.

This popular Edinburgh text-book is too well known to require any detailed review. The present edition does not present any marked alteration as compared with the last in these two first volumes. The work is specially notable for the number and excellence of the illustrations, and the neat, handy volumes into which the book is divided. Operative surgery is relegated to a separate volume, and the absence of description of operations as part of the treatment of various surgical conditions has both advantages and drawbacks. In such matters, for example, as the treatment of fractures and cleft palate it is difficult to present the problem fairly unless some description and illustration of operations are given. We think that a more complete account might have been given of infections of the fingers and hand on the lines of Kanavel's work. The figure (145) illustrating the X-ray appearance of a myeloma is poor and not at all typical. We think that the statement that the treatment of osteitis fibrosa is merely protective requires amplification.

In describing treatment of cancer of the tongue it is stated that the tongue should be removed by the thermocautery; but no mention is made of diathermy, which surely is an easier and a much more thorough method which causes very little pain.

Speaking generally this manual is an excellent description of surgical diseases, but it is rather deficient as a guide to treatment.

Young's Practice of Urology: Based on a Study of 1,500 Cases. By HUGH H. YOUNG and DAVID M. DAVIS; with the collaboration of FRANKLIN P. JOHNSON. 2 vols. 8vo. Pp. 1433, with 1010 illustrations, 20 in colours, by William P. Didusch. 1926. London and Philadelphia: W. B. Saunders Company, Ltd. £5 5s. net.

This monumental work is based on the study of 12,500 histories of urologic cases taken from the files of the James Buchanan Brady Urologic Institute, and completed by a thorough and elaborate 'follow-up' system. Its great value is that it represents the personal effort of a surgeon universally recognized as one of the chief authorities on urology, and everywhere does it bear the stamp of marked originality—though full consideration and appropriate recognition are given to the work of others. Every branch of the subject is treated in a thoroughly practical fashion, and although theoretical questions are fully discussed whenever they have any practical bearing, yet practicability remains throughout as the outstanding feature. The general arrangement of the subject has been carried out mainly on a pathological basis, the authors rightly considering a thorough knowledge of the pathology of each condition dealt with as essential to the proper understanding of its treatment. The detailed description of the technique of surgical procedures is separately considered in the second volume, much unnecessary repetition being thereby avoided.

The opening chapter deals with the physiology and pathology of micturition, and incorporates much original work of Dr. Young and his assistants. The relation

of the 'trigonal' muscle to Mercier's bar and the uvula vesicæ is fully described, and the important part played by this muscle in *actively* opening the internal sphincter during the act of micturition is strongly insisted upon. A very complete account is given of the neurologic lesions of the bladder and of the troubles of micturition consequent upon tubercles and other diseases of the spinal cord.

The second chapter, one of the best, deals with the 'obstructive uropathy'. The results of recent research upon the production of hydronephrosis by ligation of the ureter combined with partial obstruction of the renal artery or vein indicate that arterial obstruction hastens the progress of hydronephrotic atrophy: the renal atrophy consequent upon renal back-pressure is only in small part due to direct pressure upon the renal cells, the main cause being pressure-interference with the blood-supply. Diverticula of the bladder, congenital and acquired, are excellently described and illustrated. Laboratory tests for the estimation of renal function receive very special attention, and a new instrument—the phthaleinometer—is presented for the rapid estimation of the drug excreted in the phenolsulphone-phthalein test, which of all the excretory tests is that most strongly recommended. The value of laboratory tests of renal function is thoroughly discussed; the judicious conclusions arrived at are: (1) They supplement but do not replace observation of the patient; (2) The additional information obtained from laboratory tests is indispensable; (3) No single laboratory test proves anything; it is merely another element in the complete clinical picture we are trying to construct. In the treatment of obstructive uropathy the guiding principles are clearly and concisely enunciated, and the importance of avoiding operation until the renal function has reached its 'optimum' level is rightly insisted upon. "The future of the patient is decided much more, at the present time, by the care and skill displayed in the ward before operation than it is in the operating room itself". In cases of chronic vesical distention with long-standing renal back-pressure, the great danger of a too sudden relief of this pressure is strongly emphasized, and an account is given of the Young-Shaw apparatus by which a very gradual decompression can be safely achieved.

A special feature of the third chapter—on general urogenital infections—is the full description of the special technique for urologic bacteriology, including the collection of specimens, dried smears, staining methods, and culture media. The pathology, symptoms, diagnosis, and non-operative treatment of all the general infective diseases of the urogenital tract are fully described, particularly excellent being the account of those due to the gonococcus and the *B. typhosus*. Since 1917 extensive researches have been conducted at the Brady Urologic Institute in the field of urinary antiseptics, and some 265 different combinations of germicides with phenolsulphonephthalein have been tested, of which No. 220—'mercurochrome'—and No. 253—'meroxyl'—are advocated. Mercurochrome has been largely used as a local antiseptic to wounds and mucous membranes, intravenously in cases of septicæmia from colon bacillus, staphylococci, and streptococci infection, and in the treatment of pneumonia, genito-urinary infections, gonorrhœal urethritis and arthritis, furunculosis, cellulitis, and abscess. It is injected intravenously in 1 per cent solution up to 5 to 10 mgrm. per kilo. of body-weight. The results are given in tabular form, and many striking and beneficial effects are claimed; so striking, in fact, that it is suggested they cannot be due entirely to the direct destructive or inhibitive action of the drug, but are largely the effect of the indirect stimulation of the defences of the body.

In the section on tuberculosis it is held that the vesiculæ seminales are the primary and principal seat of the infection, and that the epididymis is usually involved by lymphatic extension along the vas deferens, the globus minor being first involved. The results of simple castration and epididymectomy are stated to be very poor, and, in consequence, the operative treatment recommended for tuberculous epididymitis is extremely radical—consisting of removal of the seminal vesicles, ampullæ, and both lateral lobes of the prostate through the perineum, after which the epididymis (and testicle also, if involved) and vas deferens are extracted through an incision in the groin (or both groins in bilateral cases).

In the chapter on 'urolithiasis' we would draw attention especially to the

excellent account of Kelly's 'wax-tip' method in the diagnosis of renal and ureteral calculi, and also to the indications for operative treatment in bilateral renal calculi.

The authors do not enter into any discussion as to the essential nature of 'benign hypertrophy of the prostate', but are content with the statement of their belief that the process is a hyperplastic and not a neoplastic one. They accept the view of Motz and Pearnearnu that all these hypertrophies arise from the mucosal or sub-urethral glands. Their records show that, of prostates which cause obstruction, 20 per cent are carcinomatous, and of these fully half are hypertrophies associated with carcinoma. The special cystoscopic technique necessary in benign hypertrophy is very fully detailed, as is also its pre-operative treatment. Dr. Young shows that radical suprapubic prostatectomy had been carried out in America many years before Freyer operated upon his first case. The operative treatment advised for benign hypertrophy is Young's conservative perineal prostatectomy: this has been performed in the Clinic 1049 times, with 36 deaths, a mortality of 3.4 per cent; whereas for 108 suprapubic prostatectomies the mortality was 8.2 per cent.

In the chapter on neoplasms, which completes the first volume, the term 'nephroma' is preferred to 'hypernephroma', since it does not commit one to the unproved theory of its adrenal origin. In malignant renal tumours the trans-peritoneal operation is preferred, and a wide removal of the perinephric fat and of the peritoneum covering the anterior surface of the kidney is advised. The use of radium and X rays in the treatment of malignant disease of the kidney, bladder, and prostate is exhaustively detailed, and many special radium applicators are described.

The second volume opens with a very complete account of the malformations and abnormalities of the urogenital tract, including a case of true lateral hermaphroditism. Chapter XII—on the diagnostic significance of special urologic symptoms—will prove extremely useful to the general practitioner, and that following it on the examination of the urologic patient is of great value to both practitioner and specialist. The rest of the volume is devoted to the detailed technique of operations upon the genito-urinary tract, the various procedures being very completely described and illustrated. In addition to the operative procedures already referred to, mention must be made of Young's original operations for the radical treatment of cancer of the prostate, of malignant growth of the testis, of epithelioma of the penis, of vesical diverticula, and of the 'punch' operation for contracture of the vesical orifice. Total cystectomy has never been done at the Brady Clinic, and is not considered justifiable. Many original instruments are referred to, including Young's well-known prostatic tractor, cystoscopic rongeur, evacuating cystoscopic lithotrite, prostatic punch, and automatic perineal elevator.

The work is extremely well and artistically illustrated with over 1000 figures, mostly original, and 20 beautifully coloured plates. It constitutes the most complete, original, and practical description of urologic surgery yet produced, and will undoubtedly take its place as the standard authority thereon.

Carbohydrate Metabolism and Insulin. By JOHN JAMES RICKARD MACLEOD, F.R.S., M.B., LL.D. (Abdn.), D.Sc. (Hon.) (Toronto), Professor of Physiology, University of Toronto. (Monographs on Physiology.) Demy 8vo. Pp. 357 + xii, with 33 illustrations. 1926. London: Longmans, Green & Co. 18s. net.

THIS book, the latest member of the series of *Monographs on Physiology*, is essentially an account of experimental work carried out in attempts to elucidate the nature and mechanism of the changes occurring during the metabolism of carbohydrates.

The discovery of insulin and its well-known effects offered a new means of experimental study of these problems, and it is with work leading up to, and arising out of, this discovery that the author is especially concerned. Hence he begins by tracing the development of the view that the islets of Langerhans are responsible for a specific internal secretion, and so leads up to the preparation of insulin. Then

follows an account of experimental work in which the effect of insulin on normal and diabetic animals is noted with reference to the various criteria which have been used in the study of sugar metabolism. Finally, he discusses the mechanism of the action of insulin in the light of these results.

It will be noted that the book is in no sense a treatise on diabetes. Hence it makes no direct appeal to the clinician. Nevertheless a careful reading of it will not fail to add something of interest and value to his understanding of this disease. Especially may this be said of the chapters on hyperglycæmia and hypoglycæmia. The surgeon will find interest in the account of hyperglycæmia following general anaesthesia and the effect of insulin in preventing and modifying it; but its possible relation to post-operative acidosis is not dealt with.

Undoubtedly the book's chief appeal is to the experimentalist, since it gives with considerable care and patience a summary of the work done in this important field, together with an attempt to assess the value of the results obtained. Moreover, it shows that many problems are still unsolved, and thus indicates the lines along which further useful work may be attempted. Its value in this respect is enhanced by the very useful bibliography following each chapter.

Praktikum der zahnärztlichen Chirurgie. By DR. BERNHARD STEINER, Demonstrator at the Dental Institute of the University of Vienna. Demy 8vo. Pp. 199, with 113 illustrations and 2 plates. 1926. Vienna and Berlin: Urban & Schwarzenberg. M. 9; bound, M. 10.80.

THIS book, as the title indicates, deals with the surgical aspect of dental surgery, and is particularly welcome for that reason, as there are very few books which embrace the subjects dealt with in this volume. These include extractions, resection of roots, cysts, and replantation, with chapters on anatomy and anaesthesia.

On the subject of anaesthetics the author clearly indicates his choice of local anaesthesia whenever possible, using a freshly-made novocain-adrenalin solution varying from 1 to 4 per cent. He mentions that the firm of Woelm are introducing ampoules in which the powder and liquid are separated by an easily-fused metal plug, which when fused causes the powder and liquid to mix and form a fresh solution. This certainly appears to be a convenient and time-saving device for use in the surgery. In describing the details of the use of local anaesthetics, the author points out his preference for submucous injections when dealing with the maxilla, and gives a word of warning against inserting the needle under the periosteum. He further states that block anaesthesia for the maxilla is not to be encouraged, and should be used only in cases of absolute necessity. For mandibular anaesthesia he favours inferior dental injections, and describes a method of external injection for use in cases of infection or inability to open the mouth. Regarding general anaesthesia, he lays particular stress upon the importance of ethyl chloride, given by the open method, in preference to nitrous oxide, and quotes Levy as having given 17,000 cases without a fatal result.

The chapter on extractions is very interesting, and is well illustrated. The author divides the cases into typical and exceptional, the methods used in the former being similar to those most generally adopted in this country. In dealing with the exceptional cases, he mentions many ingenious methods of removing buried roots, etc., and gives a very clear description of his technique for the removal of impacted lower wisdom teeth, showing a preference, when dealing with severe impactions, for first cutting off the crown and then removing the root separately.

The subject of apicectomy is fully described and illustrated. The author's technique is first to fill the canal, and then to make a sufficient opening to expose the apex, and, if necessary, to refill the cut surface of the root with amalgam. He rightly stresses the importance of leaving a sloping surface of cut bone in order to permit drainage.

In the chapter dealing with cysts, the illustrations show very clearly how cysts in the maxilla invaginate into the antrum without perforating it, and also how they

are able to push their way into the nasal cavities and displace the nasal structures. In treating the operative aspect, the author advocates maintaining the orifice open by a vulcanite plate and permitting the cavity to granulate up from the base.

The remaining chapters on injuries, unerupted teeth, and epulis are disappointingly short, especially that dealing with unerupted teeth.

The book forms a very interesting addition to the library; although one may not agree with some of the operative details, it is very useful in presenting methods adopted in other countries, and well repays a careful study.

La Gastroskopie: Etude clinique et expérimentale. By JEAN RACHET, ancien Interne des Hôpitaux de Paris. Medium 8vo. Pp. 120, with 36 figures in the text and 10 plates, of which 2 are in colours. 1926. Paris: Gaston Doin et Cie. Fr. 20.

THIS is a clinical and experimental inquiry whether or not gastroscopy has a right of place in the methods of investigation of diseases of the stomach, since, although introduced more than fifty years ago, much less progress has been made therein than in all the other 'endoscopies'. In the opening chapter the author reviews the history of his subject and the various types of gastroscope that have from time to time been advocated, and decides in favour of an instrument which is straight rather than curved, rigid rather than flexible, with indirect rather than direct vision, capable of being introduced over a metallic conducting thread previously swallowed as a guide rather than blindly passed, and of comparatively small bore (27, Charrière scale). Such is the gastroscope of his chief, Dr. Benaude, and this the author has adopted in his work: the instrument and the detailed technique of its use are fully described. After stating very fairly the indications and contra-indications of gastroscopy, the conclusion arrived at is that the method, not devoid of danger, is for exceptional use only, and should never be allowed to replace other modes of gastric investigation—chemical, radiological, etc. When these fail to yield any conclusive evidence, gastroscopy should be resorted to as a possible substitute for exploratory laparotomy, but only where the services of a specialist, skilled in this procedure, are available. Moreover, since even under the most favourable conditions it is impossible to explore the whole of the gastric cavity, a negative finding does not necessarily exclude the presence of a pathological condition.

The technique of gastroscopy is described in great detail. General anaesthesia should not be used, and the local application of a 10 per cent solution of cocaine to the pharyngo-laryngeal region is recommended in combination with scopolamine and morphine hypodermically. The position of the patient during gastroscopy is very thoroughly considered from the two points of view of (1) ease of introduction of the instrument, and (2) the visibility of the gastric cavity, and it is in this connection that the results of the author's important anatomical and radiological researches in the living and on the cadaver are given. He concludes in favour of the left lateral decubitus as the routine position for clinical use: in the cadaver he has found that 'dorso-lumbar lordosis' simplifies intragastric vision, but he has not, as yet, had sufficient practice with this posture in the living subject to enable him to decide as to its advantages. The normal gastroscopic appearances are well described, and the importance of a recognition of the pylorus and of the lesser curvature is duly insisted upon. In gastric ulcer the method is particularly useful in the diagnosis of recent and superficial ulcers, which do not yield any radiological evidence of their presence: it reveals that around the actual ulcer there is, for a varying but often considerable distance, a zone of 'gastritis', where the mucosa is swollen, congested, very vascular, and frequently the seat of numerous small superficial erosions. The early diagnosis of cancer of the stomach should be assisted by gastroscopy, but, as yet, only cases where the disease is already advanced have actually been examined: the recognition of 'ulcer-cancer' is scarcely probable by gastroscopy when one considers its great difficulty even after operative exposure.

The work is well illustrated throughout, and is a very complete and impartial statement of the present position of gastroscopy as a method of clinical investigation.

The Cancer Review: A Journal of Abstracts, issued under the Direction of the British Empire Cancer Campaign. General Editor: FRANCIS CAVERS, D.Sc., M.R.C.S. Vol. I, No. 1. Royal 8vo. Pp. 80 + viii, illustrated. 1926. Bristol: John Wright & Sons Ltd. 30s. per annum (10 numbers); single numbers, 3s. 6d. net.

By a sad coincidence the death of Sir William Leishman, to whose initiative this new journal largely owes its existence, has preceded the issue of the first number.

The Cancer Review is issued under the auspices of the British Empire Cancer Campaign, and its object is the publication of abstracts and views of the current contributions to the ever-increasing literature on cancer. The idea is to include in the *Review* an abstract of every important publication bearing on the problems of cancer research in the widest sense. Clinical papers, as well as purely pathological ones, are included in the scope of the *Review*. It is evident, therefore, that it will be indispensable to all surgeons who wish to keep abreast of current knowledge of cancer, as well as to pathologists.

The *Review* is under the General Editorship of Francis Cavers, D.Sc., M.R.C.S., assisted by an able Editorial Committee which is composed of well-known pathologists and clinicians who are especially interested in the study of the disease.

This first number contains 127 abstracts derived from the literature of the world. It is printed in large clear type on good paper which enables a reader in the course of an hour or two's study to find out what is being done at the moment by research workers everywhere. The editorial work has been carefully done, and brevity has been attained without any loss of intelligibility. The publication of such a journal cannot fail to stimulate research, to prevent waste of effort and overlapping, and to assist clinicians in treating the disease.

The British Empire Cancer Campaign, in establishing the journal, has performed a notable public service.

The Surgery of Gastro-duodenal Ulceration. By CHARLES A. PANNETT, B.Sc., M.D. (Lond.), F.R.C.S. (Eng.), Professor of Surgery in the University of London, Surgeon to St. Mary's Hospital. Demy 8vo. Pp. 154, illustrated. 1926. London. Humphrey Milford, Oxford University Press. 10s. 6d. net.

It would be impossible in a short book, such as this is, to deal with the subject of gastro-duodenal ulceration exhaustively, and the author must be congratulated on the concise manner in which he has placed before the reader what he describes in his preface as a fair view of the problems which confront the surgeon who seeks to bring relief to the victims of this crippling disease.

We seem to have got very little further in the pathology and etiology of ulceration, and in the first two chapters the author contents himself with shortly epitomizing the most authoritative views under these two headings. One or two points may be mentioned as of some importance. The first is the statement that the commonest situation for a duodenal ulcer is the pancreatic wall at the junction of the first and second parts. We do not think this will meet with general acceptance. Again, as to the recognition of a duodenal ulcer on the operating table, the author states that the pyloric vein is not a sufficiently reliable guide, and he finds it difficult to differentiate sometimes between duodenal and gastric ulcers in consequence. We think there can seldom be any difficulty in this matter if the white line of the pylorus be observed as well as the pyloric vein, for these two bear a very constant relationship to each other. A third point is the question of malignant change in gastric ulcers. This is a very difficult subject, for the evidence of malignant disease recognized by some is strenuously opposed by others, especially that which consists of detached epithelial cells; the former regard these as definite evidence of a malignant transformation, whereas the latter are equally convinced that they are cells isolated by fibrous tissue during attempts at healing. As the author says, if these are evidence of a malignant change, it is a curious thing, considering that they are observed in upwards of 70 per cent of cases, that cancer is not seen with great frequency after treating the gastric ulcer by gastro-enterostomy alone. We think he sums up the matter very fairly when he says, "it therefore seems clear that whilst

the likelihood of cancer development is not nearly so great as some American surgeons believe, yet it is a distinct danger to be reckoned with, and it suggests that it is always preferable to resect a simple ulcer of the stomach whenever the operation is not contra-indicated on technical or some other equally adequate grounds."

In Chapter 3 symptomatology is discussed. There is nothing new in this section. The author says that the first symptom of a chronic gastric ulcer may be perforation or hæmorrhage. We think this must be a very rare event: a careful inquiry will almost always elicit the previous existence of symptoms, and we do not agree that duodenal ulcer is difficult to diagnose clinically; on the contrary, it is one of the easiest abdominal lesions to be sure of, if the earliest periods of the patient's complaint of symptoms be thoroughly investigated: later the character of the symptoms changes, and an anamnesis of this period alone would certainly lead to confusion.

Chapters 4, 5, and 6 deal with the surgical treatment of ulcer. In the first of these the physiological effects of the operations usually performed are considered. This is quite a good chapter, but as the physiology of the normal stomach is still a matter of contention, it is not surprising that there is no unanimity on the physiological aspects of the post-operative functions. The old controversy as to the mechanical or so-called physiological action of gastrojejunostomy is dealt with, and though the author seems to belong to the latter school of thought, we do not think he establishes his position any too securely.

With regard to the operations performed for gastric ulcer, we find ourselves in complete agreement with the author when he says that an operation such as gastro-enterostomy, which admittedly gives less satisfactory results than those which deal with the ulcer directly, should not be performed as a routine because in the ordinary surgeon's hands it is safer. If a surgeon cannot acquire the technique to perform resection with a risk only negligibly greater than that of gastrojejunostomy, he should not undertake to operate on unperforated gastric ulcers. The author reviews the various operations performed, giving statistics of cures from authoritative sources. These, like all statistics, need to be accepted with caution. He prefers sleeve resection or Péan's operation (also called Billroth I) according to the circumstances existing, and claims that in his hands the results are better than those following resections of the Polya type.

In Chapter 6 the operative treatment of duodenal ulcer is considered. The alternatives given are gastrojejunostomy and partial duodenectomy, of which the author prefers the latter. It is a little difficult to see why, as his death-rate is 6.8 per cent in 29 cases, a mortality four times that of gastrojejunostomy. It is true the after-results of the latter operation are not ideal, but it remains to be seen whether those of duodenectomy are any better. Up to the present there seems little to choose between the operations in this respect. We regret that the author does not mention the operation of gastroduodenostomy, an operation of which most surgeons speak highly in the few cases in which they perform it, and which is attended by after-results as nearly perfect as can be.

Hæmorrhage and perforation are dealt with in Chapters 7 and 8. There is nothing new in these sections. We note that amongst the symptoms of the latter initial shock is mentioned, as it is in most text-books. This generally accepted notion is, we believe, inaccurate, as a pulse-rate of 80 or thereabouts will be found almost always in the pre-peritonitis stage.

Chapter 9 is devoted to the description of the technique employed in the operations performed. With one or two exceptions this is as the text-books describe it. We note that emphasis is laid on retaining all the mucosa exposed after opening the stomach and jejunum during the operation of gastrojejunostomy. Also, when the ulcer is fixed to the pancreas, no attempt is made to remove the base, and the adherent necrotic tissue is not treated in any way. The author says he has not seen any ill effects result from this policy. On the other hand, we have never seen any harm caused by shaving the pancreas, and a clean removal appeals to us as better surgery.

The final chapter is given to the consideration of the post-operative complications. Those which appear in the text-books are deftly dealt with, but in addition

there is a paragraph on "injuries to the bile and pancreatic ducts in duodenectomy". The author states there is a great risk of this occurring, and that it has happened in a certain proportion of cases, and adds, of course, that it is a serious matter. The results of an operation which involves this risk must be shown to be much better than those after gastro-enterostomy before it can be recommended as an alternative treatment. This book gives us the impression that the author is striving to establish this position, but we feel that he is not very convincing. There seems little to choose in the late results. Removal of the duodenal ulcer of course eliminates the chance of perforation of, or hæmorrhage from, it in after years, but these are rare events after gastrojejunostomy, and the immediate risks of duodenectomy are undoubtedly greater than those of the former operation. Moreover, it is not yet established that the fear of an anastomotic ulcer disappears; indeed, for all we know at present there may be a greater incidence. However, the operation is being given a trial, and no doubt for a while will become increasingly popular, and the book is well worth reading from this aspect.

References to unsettled problems are given at the end of each chapter, and instructive illustrations appear throughout the book.

Though there is much in the volume of which we do not approve, we think it is one which every surgeon should read. It not only gives the views and opinions of the author (and it is always refreshing and instructive to have these from the pen of an expert), but it contains those of all the leading surgeons and many experimentalists, expressed in a neat and concise manner, and also much statistical information.

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EPONYMS.

BY SIR D'ARCY POWER, K.B.E., LONDON.

XXIII. SPENCER WELLS' FORCEPS.

WHEN I was house surgeon to Sir William Savory at St. Bartholomew's Hospital in the year 1883, a single pair of spring forceps was alone provided to arrest the bleeding even in so large an operation as amputation through the middle or upper third of the thigh. At that time and for some years afterwards it was the duty of the assistant surgeon always to be present to help his chief at every operation. Amputations, the removal of tumours, ligature of arteries in their continuity, and the relief of strangulated herniæ were the usual operations, and by long association the assistant surgeon had learnt every movement of his chief, who always operated for speed. The control of the bleeding was not as difficult as might be thought. The main artery was controlled by digital pressure in cases of amputation, and, as the surgeons had all graduated through the dissecting room, each vessel was picked up in turn, ligatured with silk, and when all the normally situated vessels had been thus tied the pressure on the main vessel was relaxed and any smaller bleeding points were tied.

The need for improved mechanical means to stop bleeding was felt in places where such skilled assistance as in the older institutions was not attainable and where abdominal surgery was beginning to be practised.

Attempts were made, certainly as early as 1860, to replace the spring forceps by others with scissors handles and a catch on the shanks, but a single pair was still considered sufficient for each operation, and multiple forceps did not come into use until the little bulldog forceps which, as physiologists, we used to call Kröneckers forceps spread from the physiological laboratory to the operating theatre.*

*Mr. Alban Doran, in the typed copy of a "Descriptive Catalogue of Gynecological Instruments in the Museum of the Royal College of Surgeons of England", gives the following "Notes on the Development of the Pressure forceps. In 1853 Webber invented his anti-ligature forceps. Spencer Wells used bulldog forceps in all his earlier ovariectomies. In 1858 Charrière introduced his dressing forceps with handles, bows or rings as in scissors and a catch on the shanks just above the handles. In 1862 Koeberlé applied a Charrière's forceps to a bleeding ovarian artery: it came away spontaneously on the sixth day. In

Mr. Spencer Wells published his "Remarks on Forcippresure and the use of Pressure-Forceps in Surgery" in the *British Medical Journal*, 1879, vol. i, p. 926. He there says: "Mr. Spencer Wells (Samaritan Hospital) has introduced a kind of artery and torsion forceps, which very conveniently replace the old spring artery-forceps of Liston and the bulldogs used for the *temporary stoppage of bleeding vessels during operations*, whilst they are the most readily applied of any of the varieties of torsion forceps met with in the shops. They were first made for Mr. Wells by Krohne and Sesemann. The grasping and holding extremity is roughened by rather deeply cut transverse teeth, so that the *bleeding vessel is forcibly compressed and its coats squeezed or almost crushed together*. This is often sufficient to stop the bleeding without any torsion, especially if the instrument be left on the vessel for a minute or more. But if the vessel be large then two or more rotations may be added. Instead of the spring-catch, the fastening is effected by a Mathieu's catch in the handles. This is quite as easily fixed and opened as the spring and is much less likely to get out of order. The instrument is made of steel, but is coated with nickel, which prevents any rusting after use." This passage, quoted from an article which appeared in the *British Medical Journal* of Jan. 10, 1874 [vol. i, page 47], proves, says Mr. Spencer Wells, "that before 1874 I had employed forcippresure, not only for the *temporary* arrest of bleeding during surgical operations, but had designed forceps for the express purpose of so squeezing or crushing the coats of the bleeding vessel together, as *permanently* to stop bleeding from vessels of moderate size. I do not wish to enter into a discussion between MM. Koeberlé and Péan, nor to prove that I had preceded both of them by many years in the use of forcippresure. My chief object is to bring more prominently before the profession the many and great uses of this simple and rapid mode of stopping bleeding and describing what I believe to be the best form of pressure-forceps hitherto constructed."

"I can hardly recollect when I first began to use forceps instead of the fingers of an assistant for temporarily stopping bleeding during operations; but I believe I learned it from Mr. Bowman before he left King's College. I had often admired in the private and hospital practice of Sir William Fergusson the ready way in which Mr. Henry Smith and the late Mr. Price would instantly stop a spouting vessel by the finger and tie it at a glance from the great operator. But I well remember seeing Mr. Bowman extirpate a very large tumour from the neck, and quietly put a 'bull-dog' upon every considerable vessel as he divided it. This must have been in 1854; because when I went to the Crimea in 1855, I took a number of 'bull-dogs' with me; and after my return in 1856 I never went to any serious operation without several of different sizes. I used them in all my earlier cases of ovariotomy

1865, Verneuil secured the bleeding stump of a uterine polypus by leaving a polypus forceps attached to it for two days. In December 1865 Elser constructed Koeberlé's pince hémostatique: after October 1867 that surgeon removed the forceps at the end of the operation instead of leaving it on the vessel for a day or longer. In 1868 Gueride constructed for Péan an instrument for forcippresure—a modification, like Koeberlé's, of Charrière's, with Charrière's lock. In 1872, Spencer Wells first employed this pressure forceps after testing several designs, and in 1878 he adopted the later form with superimposed blades."



(beginning in 1858) for stopping any vessel which bled in the abdominal wall divided in the first incision. I cannot remember precisely when I began to find that the 'bull-dogs', used at first only as a means of temporary compression, were sufficient to close permanently vessels of moderate size; but in 1863 I began to increase the size of the 'bull-dogs' and to attach long pieces of silver or iron wire to them, so that when used on omental vessels, or on bleeding vessels from torn adhesions on the inner surface of the abdominal wall, they should not be forgotten or lost. Then, as torsion came into more general use, and various forms of torsion forceps were contrived, I arrived at the form of instruments described above. Mr. Krohne tells me that he made the first of these forceps for me early in 1872. Koeberlé and Péan's instruments have the great disadvantage of an open space between the blades, which admits of entanglement of one instrument with another, or of the passage of omentum or other structures. This was a fault in my own earlier instruments. It has been completely corrected in the later instruments made for me by Mr. Hawksley without at all lessening the compressing power exerted on the vessel. In October 1878 Mr. Hawkesley carefully tested the compressing power of different forceps when opened by a piece of leather one *millimètre* thick between the jaws of the forceps, and covering about four teeth from the points. The following table gives the result, as well as the force required to be exerted by the hand in closing the handles or fastening the catch or catches under each condition.

POUNDS AVOIRDUPOIS EXERTED BY FOUR TEETH OF THE END OF
THE FORCEPS WHEN ONE MILLIMETRE APART.

FORCEPS	FIRST CATCH	SECOND CATCH
Koeberlé	—	3½
Péan	8	12
S. Wells (old)	22½	—
Ditto (new)	12	22½

It may be seen that in my old instrument there is only one catch. And in my new one, the second catch only exerts the same power as the first catch of the old instrument. But this is six or seven times greater than the second catch in Koeberlé's—and nearly double that of Péan's. When only the first catch in Koeberlé's instrument is closed, the points are separated about half a *centimètre*, so that they only compress anything more than that thickness. I have used all these instruments, but find them much less handy than my own, in which the handles meet without leaving any opening between them. The rings do not admit the thumb and finger too far; and the end which compresses the vessel is so bevelled, that, if it be desirable to apply a ligature, the silk will easily slip over the forceps and not tie them together. Thus my instrument is not only useful in forcipressure and in torsion, but enables the surgeon to dispense with any other kind of artery-forceps if he wish to apply a ligature."

The history of the pressure forceps is to be found in an interesting

article by Mr. Alban Doran (*British Medical Journal*, 1915, vol. i, p. 555). It is headed: "The Development of the Pressure Forceps (Webber's—Koeberlé's—Péan's—Wells's). In Chronological Order from the Original Reports."

Thomas Spencer Wells was born at St. Albans in 1818, the eldest son of William Wells, a builder. He early showed an interest in natural science, and was apprenticed to Michael Thomas Sadler, a highly-respected general practitioner at Barnsley in Yorkshire. He lived for a year with the parish doctor at Leeds, and there attended the lectures of the second Hey and the elder Teale, whilst he followed the practice of the Leeds Infirmary. In 1836 he entered Trinity College, Dublin, and received instruction from William Stokes, Sir Philip Crampton, and Arthur Jacob. Three years later he came to St. Thomas's Hospital in London, where his education was completed under J. H. Green, Benjamin Travers, and Frederick Tyrell. At the end of his first year he was awarded a prize for the most complete and detailed account of the post-mortem examinations made during the time of his attendance at the hospital. He was admitted a Member of the Royal College of Surgeons of England in 1841, and joined the Navy as Assistant Surgeon. He served in Malta for six years, combining civil practice with his naval duties, and acquired so good a reputation as a surgeon that the honour of a Fellowship of the Royal College of Surgeons was conferred upon him in 1844. He left the Navy in 1848, and paid a visit to Paris to see the gunshot wounds coming from the barricades in the June of that year. He afterwards visited Egypt with the Marquis of Northampton and made some observations on malaria. In 1853 he began to practise in London as an ophthalmic surgeon, and in the following year he was elected surgeon to the Samaritan Free Hospital for Women and Children, which was then little more than a dispensary, and he was appointed editor of the *Medical Times and Gazette*. He resigned his posts on the outbreak of the war in the Crimea and proceeded to Smyrna, where he became surgeon to the Civil Hospital. He returned to London in 1856 and took up his former post of Surgeon to the Samaritan Hospital.

In 1848 Wells believed ovariectomy was an unjustifiable operation as surgery then stood; in April, 1854, he assisted Baker Brown at his eighth operation for the removal of an ovarian tumour. The patient died, and it was not until 1858 that Wells himself operated for a similar condition. The remainder of his life was practically a history of the operation from its earliest and imperfect stage until it became one of the routine operations of surgery. Ovariectomy was accepted by the medical profession as a legitimate operation about 1864, and its acceptance was largely due to the wise manner in which Wells conducted his earlier operations. He invited men of authority to see him operate; he published series after series of cases giving full descriptions of the successful as well as of the unsuccessful results, and he constantly modified his methods, always in the direction of greater simplicity. His operations were models of surgical procedure. He worked in absolute silence; he took the greatest care in selecting the instruments, and he submitted his assistants to a rigid discipline.

Wells may thus be looked upon as the founder of modern abdominal

surgery. He found ovariectomy a discredited operation, but even before the introduction of antiseptic methods his success was sufficient to render its performance justifiable. Coupled with the improved surgical procedure introduced by Lister, the principles governing the operation of ovariectomy have been applied to the uterus, the kidneys, the liver, the spleen, and the intestines, all of which are now subjected to surgical interference and often with the happiest results. Yet Wells had at first no easy battle to wage. The whole weight of surgical opinion was against him. His perseverance, his transparent honesty, his absolute sincerity, and his fighting powers at last overcame all opposition, and he lived to see his operation approved, adopted, and fruitful beyond all expectation.

Wells had many interests outside his profession. He was an ardent advocate for cremation; he was a good judge of horses, rode well, and, in later life, was to be seen daily driving himself in a phaeton with a well-matched pair of horses from his house in Golders Green to his rooms in London.

He was President of the Royal College of Surgeons of England in 1883, and in the same year he was created a baronet. He died near Cannes in 1897, and his body was cremated at Woking. He left five daughters and one son by his wife, Elizabeth Lucas, daughter of James Wright, solicitor, of Sydenham, who practised in New Inn.

* * * * *

The portrait is from an oil painting by Rudolf Lehmann hanging in the hall of the Royal College of Surgeons of England. It represents Spencer Wells in his robes as President of the Royal College of Surgeons.

ACUTE PANCREATITIS.

By DIGBY CHAMBERLAIN, LEEDS.

ACUTE pancreatitis is the most acute, agonizing, and one of the most fatal conditions which we are called upon to treat inside the abdomen. The severity of the pain and its sudden onset cause the sufferer to seek immediate advice. In a number of cases the label 'acute abdomen' is loosely applied, not because the disease presents any difficulty in diagnosis, but because it is not kept in mind by the observer. Deaver says, "Unless a surgeon has seen previously two or three cases of acute pancreatitis, or unless he keeps the condition constantly in mind, it is seldom that a correct diagnosis is made before opening the abdomen".

Diagnosis.—I do not wish to go over the symptoms of the disease, as they are fully and accurately recorded elsewhere, but desire to emphasize their severity and the acuteness of their onset. There are two signs to which I must refer later on. The first is the marked cyanosis which was first recorded by Halstead, and the second is the discoloration in the flank due to a direct retroperitoneal digestion by the pancreatic ferments to which Grey Turner has drawn attention. If it is thought necessary to confirm the diagnosis of acute pancreatitis, Lowe's test and the diastatic value of the urine are both confirmatory. Other and more elaborate tests are not usually available in an emergency, and moreover are quite uncalled for.

Statistics.—Acute pancreatitis is an uncommon disease, only 21 cases having been treated at the General Infirmary at Leeds in the decade 1915-24. This is equivalent to one in every 5000 surgical admissions. The average age of these patients was 50, and females were attacked more frequently than males, the figures being 62 per cent and 38 per cent. Of the whole series of 21 cases, 8 died, which is equivalent to a mortality of 38 per cent. Three cases were not operated on, and two of them died. That the third case was suffering from acute pancreatitis seems almost certain, as the diastatic value of his urine was found to be 200 units. It has been stated that cases do recover without operation. We must admit this possibility, as patients are sometimes seen at operation after a supposed acute cholecystitis, when the pancreas is swollen, and large areas of fat necrosis are present. These cases have obviously recovered spontaneously from their acute attack, but we see that there is a mortality of 66 per cent for patients treated medically.

In 13 cases the treatment was drainage of the lesser sac. In these the lesser sac was opened, usually between the stomach and transverse colon, and the peritoneum covering the pancreas was incised. The pancreas was explored with the finger, and free sloughs, if present, were removed. This exploration should be very gentle, and should never be attempted with a sharp instrument, as the splenic or other vessels may be opened and give rise

to very troublesome hæmorrhage. A rubber drainage tube, carefully packed off from the rest of the abdomen by gauze swabs, was then put down to the anterior surface of the gland. Five of these cases died, which equals a mortality of 38·5 per cent. In the remaining 5 cases operated on, in addition to drainage of the lesser sac, a tube was put into the gall-bladder. One of these patients died, so that by this method the mortality is brought down to 20 per cent. Although it may be fallacious to draw conclusions from such a small series of cases, it would appear that drainage of the gall-bladder and lesser sac has only half the mortality of drainage of the lesser sac alone.

It is interesting to note that 9 cases of the series gave a history of recurrent attacks of abdominal pain, situated in the upper abdomen and continuing over a number of years. For two or three weeks these attacks had been more severe, and had culminated in the real acute attack. One case, which recovered, had had typhoid fever.

Post-mortem examination in 6 of the 8 cases which died showed: single cholesterol stone in 2 cases, multiple small stones in 1, no stones in 2, congested gall-bladder in 1. No case showed obstruction at the ampulla of Vater. In the two other cases there was no post-mortem.

Drainage.—When the question of drainage is being considered, posterior drainage of the lesser sac must be discussed. The lumbar discoloration, which has been already mentioned, is due to a digestion of the retropancreatic tissues, which, aided by gravity, extends towards the skin of the back. In one case, after operation, a fluctuating swelling appeared below the last rib on the left side, due apparently to an extension of this process. Drainage in this position would appear to be rational, and, in addition, would be assisted by gravity; but unfortunately the posterior relations of the pancreas are so numerous and important that a stab through them cannot be recommended as a routine procedure.

I have worked out anatomically what I think is the only possible method of posterior drainage. It consists in resecting a portion of the tenth left rib in the mid-axillary line, and aims at draining the lesser sac in the region of the tail of the pancreas. I have not yet had an opportunity of employing it on a patient. When I have been able to do so, I hope to publish the method in detail.

Sequelæ.—I have been able to follow up only 6 of the 13 cases which recovered. Two of them are dead, one eight years and the other two years after operation. Both these cases were elderly men, one being 72, and from the facts at my disposal it appears that they died from some other cause. The remaining 4 are tolerably well. Three complain of a certain amount of indigestion, but say that, with careful attention to their diet, they are quite comfortable. This indigestion is to be explained by the deficiency in pancreatic juice, and the administration of liquor pancreaticus is of considerable advantage to them. The fourth case was a woman who has had three children since she was operated on.

Although they do not appear in these cases, there are more definite sequelæ in other cases which have been brought to my notice. In one patient a cystic swelling made its appearance in the upper abdomen after the wound had been allowed to close. A second operation was undertaken, when a false

pancreatic cyst was found and drained. Complete recovery followed. A second case has developed a pancreatic fistula, which is still discharging eleven months after the original operation. If the drainage tube had been taken out early in this case and the wound had been allowed to close, a cyst would almost certainly have developed. On the other hand, if the tube is left in too long, the walls of the track become sclerosed, epithelialization takes place from the surface, and a permanent sinus may be the result. It appears, therefore, that the tube should be removed as early as possible, but never until the discharge has become small in amount.

A dangerous time in the convalescence of these cases is from the tenth to the fourteenth days, when the sloughs are beginning to separate. There is a risk of secondary hæmorrhage, and there is a recrudescence of pain and a rise of temperature, due to interference with the drainage. When this period has been successfully negotiated the chances of the patient's eventual recovery are practically certain.

PATHOLOGY.

Pathologically it is found that the pancreas is the seat of an inflammatory swelling, which becomes tense and presses on the cœliac plexus, and so the acute nature of the pain and the severe accompanying shock are explained. This is followed by an effusion into the lesser sac of the peritoneum, which later suppurates and accounts for the fullness or swelling in the upper abdomen. This exudate then finds its way through the foramen of Winslow, and a general involvement of the peritoneum results. Scattered throughout the abdomen and elsewhere, areas are seen where the pancreatic lipase which has been liberated has saponified the neutral fats.

There appear to be five possible causes of these findings: (1) An auto-digestion of the pancreas; (2) An infection of the pancreas; (3) Hæmorrhage and digestion of the clot; (4) Pancreatic calculi; (5) A combination of (1) and (2). That the pancreatic ferments take some action in the process is shown by the presence of fat necrosis and by the lumbar discoloration, to which attention has been directed. Trypsinogen can be activated by enterokinase or by infection, but not by the action of normal bile. At one time acute pancreatitis was thought to be due to a regurgitation of intestinal contents through the ampulla of Vater, organisms being in this way brought to the pancreas, but this theory has now been abandoned. If this regurgitation does not take place, trypsinogen cannot be activated by the succus entericus and must be activated by infection. Hæmorrhage can be definitely excluded when it is remembered that trauma and scurvy may both be the cause of bleeding into the pancreas, but that in neither of these conditions does an acute pancreatitis supervene. A calculus might cause an area of lowered vitality which would be vulnerable to organisms present in the circulation; by blocking a duct it might increase the virulence of organisms already present, as occurs in obstruction of the lumen of the appendix: but as it has been shown that the pancreatic ducts are normally sterile, and as the association of acute pancreatitis with calculi has not been observed, this theory of causation must be abandoned.

The cyanosis which is such a marked feature of these cases probably depends on the presence of a septicæmia; this is a further point in favour of an infectious origin. Once trypsinogen has been converted into trypsin by an infective agent, autodigestion occurs, lipase is liberated, is activated merely by contact with normal tissues, and produces areas of fat necrosis.

The source of the infection might be: (1) Regurgitation of infected bile into the pancreas; (2) Lymphatic infection of the pancreas from the gall-bladder; (3) Infection from an inflamed common bile-duct; and (4) Infection from elsewhere.

I have had the opportunity of examining the bile in four cases of the disease at the time of operation, and in all of them a hæmolytic streptococcus was present. On superficial examination the gall-bladder appeared to be perfectly healthy in three of these cases; in the other case obvious disease was present. The gall-bladder would therefore appear to be the site of the infection.

With regard to (3), Maugeret has shown that in none of these cases is an inflammation of the mucosa of the common duct present. It is therefore impossible for infection to extend directly into the gland from this source, an attractive suggestion when it is remembered that in a large percentage of cases the common duct is embedded in the head of the pancreas.

The next question is as to whether the infection reaches the pancreas by way of the bile or by the lymphatics. That the latter is likely has been shown by Deaver and by Maugeret, who have emphasized the very close anatomical connections between the lymphatics of the gall-bladder and pancreas. Lymph from the gall-bladder normally drains into

the glands at the hilum of the liver, but once these glands are blocked, a retrograde flow takes place into the pancreatic lymph channels. In spite of this it is widely held that the regurgitation of bile along the duct of Wirsung is the causative factor. In order to determine the possible anatomical variations and the possibilities of the regurgitation theory, I have examined the junction of the common bile-duct with the pancreatic duct in 100 consecutive post-mortem cases. This has previously been done by Mann,

		AUTHOR Per cent	MANN Per cent
a.	Separate ..	28	31
	1 inch ..	23	45
	1/2 inch ..	19	
b.	1/4 inch ..	4	20
	1/2 inch ..	21	
	3/4 inch ..	3	
c.	Duct of Santorini ..	2	4
		100	100

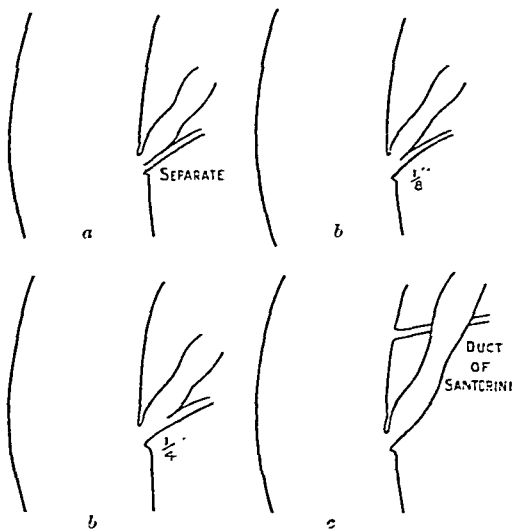


FIG. 223.—Anatomical variations in the openings of the common bile-duct and pancreatic duct.

whose figures I give also. The types appear to be : (a) Where the two ducts open separately into the duodenum at the apex of a papilla ; (b) Where they join together to form a common channel of varying length which opens on the papilla ; and (c) Where the duct of Wirsung is small and drains into the duct of Santorini, which becomes the chief duct of the gland. (Fig. 223.)

The opening of this common channel takes place on the summit of a papilla in two cases out of three ; in the remaining case the opening is either flush with the duodenal mucosa, or is in a depression covered over by one of the *valvulae conniventes*.

In one normal case there was bile staining of the pancreatic duct, showing (1) that bile may regurgitate, but (2) if it is healthy it does not cause an acute pancreatitis. Blockage of the ampulla and regurgitation of bile along the

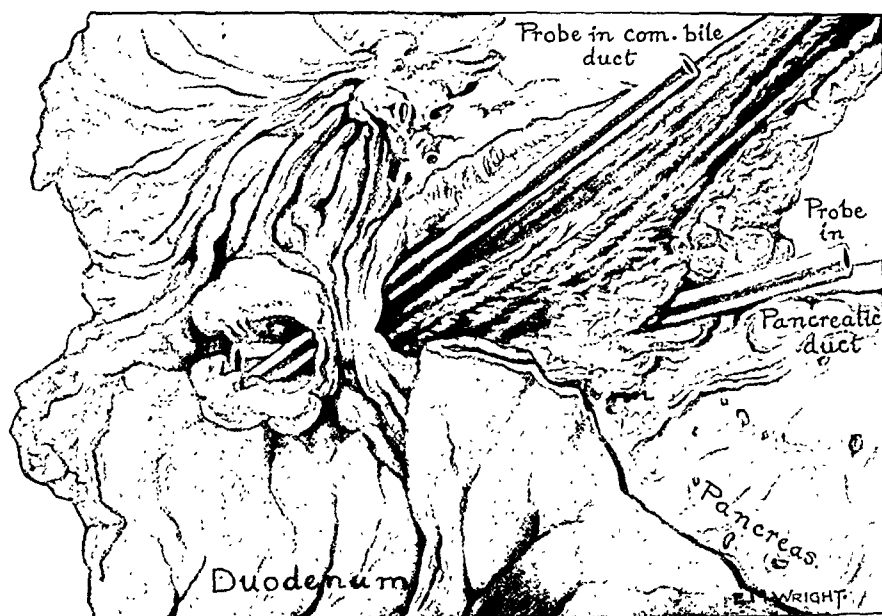


FIG. 224.—Sarcoma involving ampulla of Vater.

pancreatic duct would seem to be possible in 47 per cent of cases, but Judd has shown that the sphincter of Oddi embraces the terminations of the two ducts in 95.5 per cent of bodies. If this muscle is thrown into spasm, it compresses the openings of both ducts, and it is only in the remaining 4.5 per cent that regurgitation is possible. That it can only occur in this small percentage of cases might account for the rarity of the condition.

One fact strongly against this theory has been very obvious. At the point of junction of the ducts, as they are getting closer together, one side of one duct and one side of the other fuse, and this common wall becomes thinner until it is represented by two layers of epithelium with some connective tissue separating them. This thin wall is prolonged down for some distance, so that if the common bile-duct is laid open, it appears as if the opening into

the pancreatic duct were guarded by a valve, and I have very little doubt that this fold acts normally as a valve. As the common bile-duct is many times bigger in section than the pancreatic duct, this valve could not prevent a flow from the pancreatic into the common bile-duct, but is only competent when called upon to prevent a flow in the reverse direction. If an obstruction takes place at the ampulla, bile and pancreatic juice will be held back, and as the pressure rises this valve will close. The only thing that can open the valve is the secretory pressure of the pancreatic juice, and if this causes a flow, it will, of course, be into, and never from, the common bile-duct, which would be necessary if the regurgitation theory were the correct one.

Among my 100 cases were 4 of acute pancreatitis. In one (*Fig. 224*) there was a sarcoma of the duodenal wall involving the ampulla of Vater, but on account of the extent of the growth it was not possible to make out the exact relations of the ducts to one another. The second case showed a small polypus at the ampulla, narrowing but not occluding its lumen, and the ducts were arranged as in *Fig. 225*. The pancreatic and common bile-ducts joined together to form a common channel $\frac{1}{4}$ in. long which opened on the summit of a papilla. The third case showed no pathological condition in the ducts, which had the same anatomical relations as the second case, except that this common channel was $\frac{3}{8}$ in. long. The fourth case had exactly the same anatomical structure as the third case, but the gall-bladder was acutely inflamed and full of stones, three of which had found their way into the common duct, but were not impacted at the ampulla.

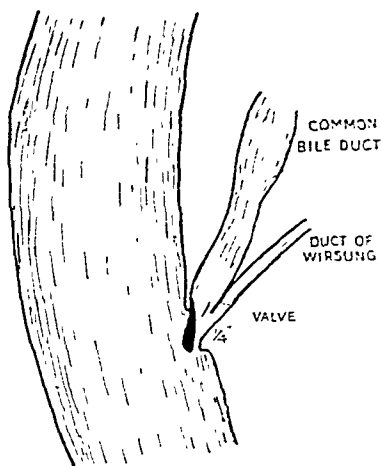


FIG. 225.—Ampulla of Vater with polypus. The nature of the valve guarding the duct is seen.

Post-mortem notes of two cases read as follows: (1) Slough present, consisting of anterior part of middle of pancreas; head and tail appear normal. Pancreatic duct normal. (2) Pancreas normal except for a superficial abscess of the head. From this it appears that the lesion does not start in the head of the pancreas in the neighbourhood of the duct of Wirsung, but on the anterior surface of the gland. If infection spreads by the ducts, it is quite reasonable to suppose that the part attacked might be in connection with the smaller ducts on the surface of the gland, but not necessarily anteriorly. The lymphatics from the gall-bladder are in close connection with those lying on the surface of the pancreas, and these two cases appear to support the probability of an infection by this route. An infection of the smaller ducts would be just as likely to attack the tail or posterior surface of the gland.

The two cases where a definite lesion was found at the ampulla might seem to indicate a blockage there, with regurgitation of bile along the pancreatic duct. The polypus did not completely block the ampulla, but tended rather

to hold it open, and the sarcoma, by making its walls rigid, probably also kept it patent. These lesions, by keeping the ampulla open, probably allowed an infection to enter the ducts and to ascend to the gall-bladder, from which the pancreas became infected.

CONCLUSIONS.

1. In acute pancreatitis there is an infection of the gall-bladder, caused by a hæmolytic streptococcus.
2. Infection travels to the pancreas by way of the lymphatics.
3. Regurgitation of bile along the pancreatic duct is prevented by a valve which guards its opening.
4. The treatment is operative.
5. Operation should consist in drainage of the lesser sac and gall-bladder.
6. As the infection is streptococcal, serum therapy might be tried with advantage.

I am indebted to the Honorary Staff of the General Infirmary at Leeds for the help they have given me in the preparation of this paper, and for the clinical and pathological material which they have placed at my disposal.

ON LEPTOMENINGIOMAS (ENDOTHELIOMAS) OF THE SPINAL CORD.*

By J. R. LEARMONTH, GLASGOW.

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I. FOREWORD.

IN the following essay I have attempted to give a full account of those interesting tumours of the spinal cord hitherto named 'endotheliomas' or 'psammomas'. They have attracted the attention of many notable workers : among others, Sir John Bland-Sutton, Professor Harvey Cushing, and Dr. Mallory have advanced our knowledge of their pathological and clinical features.

In restricting my research to the features of a single type of tumour I have followed advice given to me by Dr. L. B. Wilson, Director of the Mayo Foundation. Professor Harvey Cushing (Cavendish Lecture, 1922, June 13) holds similar views ; when indicating the lines along which advance may be

* A thesis founded upon work done during the tenure of a Medical Research Council Fellowship in Surgery in the Mayo Foundation (Mayo Clinic), Rochester, Minn., United States of America.

made in neurological surgery he says, ". . . what is perhaps better still, we may restrict our analysis to tumours of a single type in a given situation". In the preparation of my thesis I have had the privilege of access to all the records and facilities of the Mayo Clinic (through the Mayo Foundation), a privilege the value of which I cannot overestimate, extended to me with characteristic courtesy by Drs. A. W. Adson and H. E. Robertson. In addition I have included in my analysis cases reported in the literature from the year 1918 onward.

II. HISTORICAL INTRODUCTION.

The three great periods in the evolution of the science of pathology are reflected in the series of names which have been applied to the tumour which forms the subject of this essay. In the first period attention was directed to the local relations of growths, and to their ecology. After the advent of cellular pathology tumours were classified and reclassified in accordance with changing opinion as to the morphology of their cells. At the present time pathologists have come to regard embryology as an ancillary science, and attempt to classify neoplasms according to their ultimate origin.

Leptomeningiomas were first described within the skull, and so long ago as 1835 Cruveilhier depicted these growths, to which he applied the term *tumeurs cancéreuses des méninges*; although by the older writers they had been called *fungi duræ matris*. Some twenty years later Paget, at a loss for a satisfactory name, suggested that of *myeloid tumour*, while contemporary French opinion leaned toward the term *tumeur fibroplastique*. A little later Virchow, who had noted the occurrence of sand grains on the inner surface of the dura (a condition which he called 'meningitis arenosa'), proposed the term *psammoma* on the ground that he had observed similar sand bodies in the substance of such growths—a descriptive name still applied to certain specimens. Still later the same authority classified the tumour under the heading *sarcome der dura mater*. After a time this ceased to be sufficiently descriptive for the French school, which qualified the generic title in the term *sarcome angiolithique*.

About the same period His had proposed to classify the cells lining certain tissue spaces as *endothelium*. Golgi, believing that these tumours arose from so-called endothelial cells lining the perivascular spaces of the dura, introduced the word *endothelioma* into the terminology, and up to the present time it has been generally accepted and is employed in the prevailing nomenclature. From time to time various histologists have added descriptive adjectives to this name; thus Bizzozero and Bozzolo subdivided those growths appearing to spring from the dura mater into three groups: (1) *Sarcoma endothelioides alveolare*; (2) *Sarcoma endothelioides fasciculatum*; (3) *Fibroma endothelioides*. These names were intended to indicate the manner of arrangement of the tumour cells and their proportion relative to stroma.

It is a remarkable fact that, from a comparatively early period of cellular pathology, one is able to trace a minority of observers who appreciated the true origin of these growths. So far as I can ascertain, the first to draw attention to their close relationship to the arachnoid was Professor John

Cleland, of Glasgow University. In a paper which will still repay careful study he noted this relationship in two cases of brain tumour observed in his dissecting room. Histologically both growths were 'endothelioma'. A few years later Robin attributed similar growths to the soft membranes, and in accordance with the terminology of his time suggested the name *epithelioma*. In the light of recent research, which will be discussed hereafter, Robin would appear to have been nearer the truth than he knew.*

More than thirty years afterwards, though from a somewhat different approach, Schmidt arrived at the same conclusion regarding their origin. After an exhaustive histological study of the dura, he pointed out the unquestionable likeness of the islands of cells which are found among the strands of that membrane to the tufts of the arachnoid; and, further, that the cells forming these nests closely resembled the proper cells of an 'endothelioma'. Bland-Sutton has for many years upheld the arachnoid as the origin of the 'endotheliomas', a hypothesis which he reached upon similar grounds, though independently of Schmidt. In recent years Mallory from the histological side, and Cushing from the point of view of the surgical pathologist, have verified their origin from the arachnoid. Mallory in his paper, accepting the embryological origin of the arachnoid as from mesenchyme, proposed for them the term *arachnoid fibroblastoma*. The name cannot be discarded lightly, since—as will be shown later—the tumour cells have a definite fibroblastic potentiality. On the other hand, in view of the doubt which has been cast recently upon the mesodermal origin of the soft membranes, the less dogmatic term *meningioma* proposed by Cushing might be preferred. This observer based his view upon the fact that the so-called endotheliomas occur in those situations where arachnoid villi are found, or where buds of that membrane project into the dura, as well as upon histological grounds. As a compromise until the embryological controversy is settled, I would suggest the use of the term *leptomeningioma*, as denoting the source of the tumour without indicating its ultimate origin, and in my paper this name will be used. At the present time there can be no doubt that the leptomeningiomas arise from the soft membranes, and a more detailed consideration of the two theories concerning the development of these now becomes necessary.

III. DEVELOPMENT OF THE ARACHNOID.

Epiblastic Hypothesis.—Recently Harvey and Burr have doubted the origin of the leptomeninges from mesoderm. In the course of an inquiry into the manner of healing of the meninges, the former observer had noted that in the presence of an intact leptomeninges the dura healed without adhesion to the underlying membrane. This healing took place through a direct transformation of adjacent mesodermal cells into dura, and not from ingrowth of 'mesothelium' from the edges of the defect—a finding which seemed to indicate "some fundamental histogenetic difference between these two

* In the eighties, when Robin's paper was published, the cells lining serous spaces were classified as epithelium.

structures". Now Harrison has shown that the cells forming nerve-sheaths are derived from the neural crest; and nerve-sheath is to nerve-filament as leptomeninx is to central nervous system. The possibility of an epiblastic origin of the soft membranes was tested in a brilliant set of experiments involving the transplantation to a more caudal somite of portions of the cerebral vesicles of *Amblystoma punctatum*. The results of these experiments may be quoted:—

"The first series was that in which the mid-brain, optic vesicle, and the adjacent neural crest cells were transplanted into the region lying just anterior to the limb. The result of the procedure was that the transplanted neural tissue was completely invested by leptomeninx and dura. The second series involved the transplantation of a portion of the cerebral hemisphere into the same region, after the careful removal of neural crest cells. Examination of the result showed the growth of neural tissue with no leptomeninx, it being surrounded only by an incompletely formed dura".

This embryonic arachnoid is at first arranged as a syncytial mass, the meshes of which are comparatively small. The nuclei are oval and the greater part of the cytoplasm forms the connecting strands of the meshwork. As a result of the liberation of cerebrospinal fluid through the apertures at the caudal end of the fourth ventricle of the brain the tension within the meshes of the syncytium is increased, the more delicate protoplasmic processes rupture under the strain, become applied to the strands which have persisted, and are ultimately differentiated into the low cuboidal cells which line the trabeculae between the adult arachnoid and the pia mater. The dura is formed by a process of condensation in the mesenchyme adjacent to the arachnoid.

Through the courtesy of Drs. Harvey and Burr I have had an opportunity of examining serial sections of the embryos used in these experiments. The appearances were very striking and in my opinion convincing. It is to be regretted that the technique is so delicate that a considerable time must elapse before their results can be confirmed by independent workers.

Mesoblastic Hypothesis.—According to this the syncytium around the neural tube is derived from mesenchyme, and its spaces are widened as described above. The actual membranous part of the arachnoid is first apparent as a zone of condensation in the perineural mesenchyme; this zone represents both the outer surface of the arachnoid and the inner surface of the dura mater. Later a line of cleavage appears; as may be observed in the adult, the separation is occasionally incomplete. Following the appearance of the line of cleavage the arachnoid rapidly attains its definitive structure; the 'mesothelium' covering its outer surface gradually loses its syncytial character and becomes a layer of cells of flattened cuboidal form resembling that of the cells on its inner or neural surface. Even at the fourth or fifth month of intra-uterine life these cells disclose their fibroblastic potentiality by surrounding themselves with fine fibroglia fibrils and more rarely fibres of collagen.

According to this hypothesis the leptomeninx is entirely a mesoblastic structure; its covering cells are essentially fibroblasts, and they retain the fibril-forming properties of that type of cell.

DISCUSSION.

Although the epiblastic hypothesis of the origin of the soft membranes is at variance with the usual teaching on the subject, it is very attractive. Before the work of Harvey and Burr came to my notice I had observed under the microscope that many specimens of leptomeningioma showed a papillomatous appearance such as is seen in frankly epithelial tumours. Moreover, the crushing of the central cells of a cell whorl (*see* p. 416) is analogous to the process which occurs in the centre of a cell-nest in an epithelioma. Further, were this hypothesis to be substantiated, such pathologically similar growths as leptomeningioma, neurofibroma of the nervus acusticus, and the tumours found in von Recklinghausen's disease could be traced to an identical ultimate origin—the cells of the neural crest. Indeed, cases have been reported in which both von Recklinghausen's disease and leptomeningioma of the spinal cord have been present in the same patient, and one such which came under my notice will be referred to later. So far as I am aware neurofibroma of the eighth nerve has not been described in conjunction with leptomeningioma, but the histological appearance of that tumour is compatible with an origin from cells of the nerve-sheath, themselves derived from neural crest cells. Moreover, the fact that fibril formation occurs in leptomeningiomas (*see* p. 412) is not to be adduced as proof of their mesodermal origin, for the transition from epithelial to connective-tissue type of cell may be traced in many tumours.

In brief, then, the epiblastic origin of the arachnoid is strongly supported by experimental evidence, and not only offers a feasible explanation of the characteristics of the leptomeningiomas, but also provides a reasonable basis for their classification with other related tumours.

IV. STRUCTURE AND RELATIONS OF ADULT LEPTOMENINX.

The fully developed arachnoid is a thin transparent membrane formed of bundles of fibroglia, collagen, and a few elastic fibrils, and covered on its surfaces by low cuboidal cells (*Fig. 226*). Its outer surface is closely applied and possibly adherent in places to the inner surface of the dura mater. Trabeculae pass from its inner surface across the relatively wide space separating it from the 'pia mater',* and in the dorsal region form a distinct partition in the dorsal median line—the *septum medium posterius*.



FIG. 226.—The figure shows, from above downward: dura mater; the 'membranous' part of the arachnoid separated from the remainder; and somewhat thickened spongy tissue between the arachnoid membrane and the spinal cord. From a case of leptomeningioma of the spinal cord. ($\times 50$.)

* From every point of view a better term would be the *pial layer* of the leptomeninginx.

The membrane furnishes a covering to the *ligamentum denticulatum* and to the segmental blood-vessels from the intercostal arteries, which cross the canal to the cord. But of greatest importance for the present discussion is the arrangement of the arachnoid around the nerve-roots as they leave the spinal canal through the intervertebral foramina. Formerly it was thought that the membrane was continued for some distance along the issuing nerve-roots and finally blended with their perineurium. This conception has been disproved recently by the careful histological work of Elman, who found that it accompanies the nerve-roots, although not in actual contact with them, for only one or two millimetres; it is then reflected toward the cord, to become continuous with the covering of the roots, and finally to blend with the pial layer. The outer surface of the cul-de-sac so formed is in close contact with the inner surface of the funnel of dura as this passes to contribute to the nerve-sheath. Thus there is no direct communication between the subarachnoid and perineural spaces. (Nevertheless after an injection of lipiodol (*see* p. 450) into the cisterna magna, I have seen globules of this substance in positions corresponding to the courses of intercostal nerves.)

As the individual grows older the cells forming the covering of the arachnoid undergo localized hyperplasia in certain situations, and of these the most important are the angles formed by the membrane at its points of reflection upon the nerve-roots. Here they form clusters with pale, rather more rounded nuclei and cytoplasm which takes on the acid stain but poorly.* In certain of these clusters a process of condensation appears to take place, which results in a smaller type of cell with a nucleus richer in chromatin. These cell masses are closely applied to the dura, and often are prolonged actually into its stroma.

Such thickenings of the covering cells are found scattered irregularly over the membrane, the greatest number being situated on its dorsal aspect. These aggregations are of two types; in the first type there is a gradual transition into the normal thickness of the covering layer, while in the second type the mass is, as it were, heaped on the surface of the membrane. Histologically the cells forming these clusters are similar to those found at the intervertebral culs-de-sac; in general the cell outlines are less defined, and there is some tendency to whorl formation.

In the majority of cases these clusters of cells seem to be merely an expression of the advancing age of the individual, and may be regarded as physiological. However, the arachnoid cells undergo a similar hyperplasia under the influence of certain stimuli (*Figs. 227-229*). Thus in the presence of infection or of a foreign body there occur localized increases in the number of layers of lining cells, and those on the surface may be cast off to become actively phagocytic. When the stimulus becomes non-operative the surface layers may not return to their normal thickness, and in this way a second category of cell cluster arises. As will be discussed later, this process may be the connecting link between localized trauma to the spinal column and the

* The histological descriptions in this and the following paragraph should be compared with that of the leptomeningiomas.

FIG. 227.—From a case of chronic spinal arachnoiditis. The section passes through two cell clusters, which taper at their ends. Numerous smaller and more darkly staining nuclei are seen throughout the main mass. On the right an irregular deposit of calcium is present. ($\times 140$.)

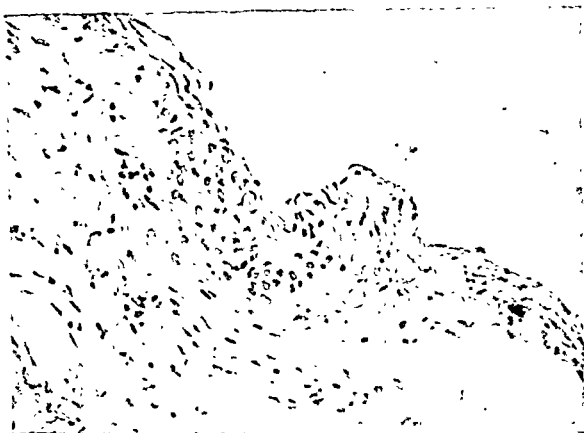


FIG. 228.—From a case of chronic spinal arachnoiditis. The section passes through a 'heaped-up' cell cluster. Note the pale rounded or oval nuclei, with little chromatin. Toward the upper free edge of the cluster the nuclei are smaller and stain more darkly, and smaller cells of the same type are present regularly throughout the mass. On the left are seen five 'sand bodies' which have formed in an older cluster. ($\times 350$.)



FIG. 229.—A similar cell cluster, showing the tendency to whorl formation. From a case of chronic spinal arachnoiditis. ($\times 500$.)



development of a leptomeningioma. Usually, however, the aggregations grow very slowly, as is reflected by the absence of mitotic figures in them. They are prone to calcareous degeneration, which may proceed to the formation of sand bodies similar to those found in the tumours under discussion (*see* p. 417). The stages in this process will be described later.

V. INCIDENCE OF LEPTOMENINGIOMAS.

In a series of 35,000 autopsies Schlesinger found spinal-cord tumours in 0.43 per cent of cases, and this figure represented 2.06 per cent of the total number of tumours. In 400 cases of such growths collected by the same observer the distribution was as under:—

Table I.—RELATIVE INCIDENCE OF ALL SPINAL-CORD TUMOURS.

	CASES
Sarcoma	107
Tuberculoma	64
Echinococcus cysts	44
Neurofibroma	37
Gumma	28
Glioma and gliosarcoma	27
Myxoma	11
Lipoma	11
Miscellaneous	47
<i>Psammoma and endothelioma</i>	24, or 6 per cent of the total number.

Frazier, on analysing a collected series of 330 tumours, found endotheliomas (25) and psammomas (13) in 38 cases, or 11.5 per cent of the total.

There appears to be a tendency to affect the female sex; the series under review contains 40 females (66.7 per cent) and 20 males (33.3 per cent), while in Frazier's collected series of similar growths females were affected in 26 cases (70.3 per cent) and males in 11 cases (29.7 per cent); in one case in the latter series the sex was not stated.

Those in the middle and later decades of life are principally affected: thus the age distribution in the cases which form the basis of this paper was as follows:—

Table II.—AGE INCIDENCE OF LEPTOMENINGIOMAS.

AGE	CASES
0-10	0
10-20	1
20-30	5
30-40	18
40-50	11
50-60	19
60-70	5
70-80	0
Not stated	1
	<hr/> 60

Such a table displaces the incidence to a slightly later age, since in many cases the symptoms of which the patient complained had been present for years before operation.

VI. OCCURRENCE WITH OTHER TUMOURS.

There are on record cases in which a patient has suffered from peripheral nerve tumours of the type described by von Recklinghausen as well as from leptomeningioma of the central nervous system. I have had the opportunity of examining such a patient, who possibly had a tumour of the left eighth nerve also (*see* p. 401).

Mr. B. P., age 20 years, first came under observation at the Mayo Clinic on April 8, 1920.

HISTORY.—He complained of bulging of the left eye, and of difficulty in walking and using his hands. At that time the following peripheral nodules were present: Two under the skin of the right antecubital fossa; one in the left ulnar nerve behind the inner epicondyle of the humerus; one near the inner head of the left gastrocnemius; one over the fibula in the left external popliteal nerve. No tumours of the skin were present.

NEUROLOGICAL EXAMINATION.—This disclosed: (1) Evidence of compression of the spinal cord at the level of the tenth dorsal segment; (2) Evidence of a tumour pressing on the left optic nerve in the orbital cavity; (3) ? Evidence of pressure upon the left eighth nerve; (4) Evidence of impairment of the function of the left ulnar nerve below the elbow.

OPERATIONS.—The patient underwent the following operations: (1) Excision of the nodules in the right antecubital fossa. Pathological diagnosis, *neurofibroma*. (2) Removal of tumour of the left orbital cavity, with the left optic nerve. Pathological diagnosis, *endothelio-psammoma*. (3) Laminectomy and removal of dorso-lateral tumour opposite the seventh and eighth dorsal vertebrae. Pathological diagnosis, *endothelio-psammoma*. (4) Removal of nodules from left ulnar nerve and left calf. Pathological diagnosis, *neurofibroma*.

SUBSEQUENT HISTORY.—In October, 1921, the patient was walking well and had developed no new symptoms. In February, 1922, he developed hoarseness. In February, 1924, he had a convulsion while asleep, and began to suffer from occipital headache. In March, 1924, he had another convulsion. This was preceded by an aura—pain in the region of the left eye passing to the right eye, and movement of the head and right eye to the right. By April, 1924, the convulsions were accompanied by aphasia, motor and (?) auditory. Attacks of petit mal were also present; these occurred two to three hours before a major attack.

When seen late in 1924 there was unmistakable evidence of progress of the disease. Thus he had occasional rapid fine jerks of the right hand, accompanied by tingling in the fourth and fifth fingers, and difficulty in finding the words he wanted to use. The left vocal cord was paralysed, and ophthalmoscopic examination showed bilateral choked discs of two to three dioptres. Additional peripheral nodules had appeared: (1) At the left angle of the lower jaw; (2) In the left sixth intercostal space in the nipple line; (3) In the right popliteal fossa.

In view of the nature of the case Dr. A. W. Adson felt he could not advise further surgical treatment.

The significance of such cases lies in the evidence they provide of a common origin for both types of tumour.

VII. PATHOLOGICAL ANATOMY.

Before the levels of the cord affected by leptomeningiomas are presented, brief reference may be made to the topographical classification of spinal-cord tumours in general. Thus they may be divided into: (1) Extradural tumours: (a) arising in the arches, (b) arising in the bodies, (c) arising in extradural fat. (2) Intradural tumours: (a) extramedullary, (b) intramedullary. These situations are shown in *Fig. 230*.

Leptomeningiomas are always intradural extramedullary tumours. This fact supports the view that they take their origin from the arachnoid; for although they are never extradural in position, yet the outermost cells of the dura, where it is separate from the bony canal, present the same histological appearance as those upon its inner surface; and the latter have been supposed to give rise to these growths.

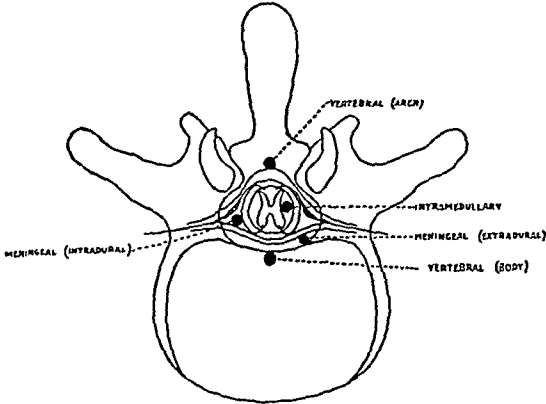


FIG. 230.—Diagram to indicate the various points of origin of tumours of the spinal cord, membranes, and vertebræ. Horizontal plane.
(From Dr. Frazier's monograph.)

Of all the cases of intradural extramedullary tumours treated at the Mayo Clinic, leptomeningiomas comprise 55.7 per cent. They are most common in the dorsal region of the cord—an incidence no doubt partly due to the greater number of segments in this portion. Thus in the series under review the relative frequency was :—

Table III.—LEVEL INCIDENCE OF LEPTOMENINGIOMAS.*

				PER CENT
Cervical cord	..	..	..	13.3
Dorsal cord	..	..	..	63.4
Lumbosacral and caudal	..	..	..	23.3

* Where the level was given in terms of bony points, this has been reduced to terms of segmental level.

Potel and Veau, as quoted by Frazier, give the figures for all spinal-cord tumours as :—

Table IV.—LEVEL INCIDENCE OF ALL SPINAL-CORD TUMOURS.

				PER CENT
Cervical cord	..	..	..	20.0
Dorsal cord	..	..	..	52.0
Lumbosacral and caudal	..	..	..	28.0

Intradural extramedullary tumours may be still further subdivided according to their situation relative to the circumference of the spinal cord. Thus a growth may be : (1) *Posterior*, behind the posterior nerve-roots; (2) *Posterolateral*, behind the dentate ligament and in front of the posterior nerve-roots; (3) *Anterolateral*, behind the anterior nerve-roots and in front of the dentate ligament; (4) *Anterior or ventral*, in front of the anterior nerve-roots.

In Table V is shown the relative incidence of the four types in the present series; for comparison, the same information with regard to all intradural extramedullary tumours collected by Frazier is also tabulated.

Table V.—INCIDENCE OF TUMOURS IN RELATION TO THE CIRCUMFERENCE OF THE SPINAL CORD.

SOURCES	ANTERIOR		ANTERO-LATERAL		POSTERIOR		POSTERO-LATERAL		NOT STATED		TOTAL	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Learmonth (collected) ..	1	1·7	11	19·3	7	12·3	38	66·7	0	0	57*	100
Frazier (collected) ..	6	7·2	9	10·8	31	37·3	31	37·3	6	7·4	83	100

* Excluding three diffuse caudal tumours.

VIII. ETIOLOGY.

Like that of all neoplasms, the etiology of leptomeningiomas is obscure. Increasing age, with its concomitant variations in the physiological activity of the arachnoid itself, is undoubtedly a factor. Cushing considers that the occurrence of these tumours within the skull may be due to herniations of the arachnoid, as a result of such long-continued increase in intracranial pressure as may be found in patients suffering from arteriosclerosis. In a certain proportion of the cases under review the blood-pressure has been recorded, and occasionally the optic fundi have been examined. A study of the findings does not reveal any marked deviation from the normal; so far as spinal leptomeningiomas are concerned, arteriosclerosis may be disregarded as a factor contributing to their origin.

With regard to the part played by trauma in initiating such a growth, attention has been drawn to localized hyperplasia of the cells covering the arachnoid, in their efforts to deal with the products of an injury. In but 3 of the 60 cases considered here was there a history of trauma. The data are shown in the following table:—

Table VI.—DATA IN CASES IN WHICH TRAUMA PRECEDED THE APPEARANCE OF LEPTOMENINGIOMAS.

AGE	SEX	INTERVAL BETWEEN BLOW AND ONSET OF SYMPTOMS	SITE OF BLOW	SEGMENTAL LEVEL OF TUMOUR
29	F	2 years (but continuous slight diffuse backache since blow)	Lower back	D 12
57	F	1 year	Lower back	C 7 - D 3
25	M	8 years	Interscapular	C 1 - C 4

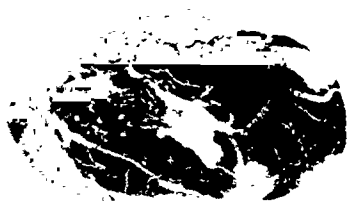
In one of the cases, therefore, there was a definite relationship between the level of the blow and the level of development of the tumour—an 'endothelioma' which partly encircled the cord. In Oustianol's case a similar relationship existed between the injury and the growth, here a 'psammoma'. While the evidence in support of the traumatic theory is meagre it cannot be ignored. Moreover, symptoms due to the tumour have often lasted so long

that a previous injury, perhaps slight, is not prominent in the mind of the patient, and unless closely questioned he may not include this point in his story.

In the course of a laminectomy for cord tumour it is not uncommon to discover evidence of chronic inflammation in the leptomeninges, and especially in its parietal layer. This takes the form of opaque local thickenings and sometimes of small cysts. Histologically the thickenings are seen to be made up of masses of arachnoid cells such as have been described (p. 402). There is an established relationship between chronic inflammation and tumour growth, and it is more than possible that one such thickening may become the starting-point of a tumour. Certainly the structural similarity between the two types of lesion is very suggestive.

IX. GROSS PATHOLOGY.

Usually the tumour has the shape of a cylinder with rounded ends, although when it is small, spherical or hemispherical forms are encountered (*Figs. 231, 232*). Since lateral expansion must occur for the most part within a limited lumen the outer and inner surfaces of the growth are commonly somewhat flattened. When the tumour extends beyond the limits of the spinal canal it has an irregular shape. Its contour is somewhat nodular, and



FIGS. 231, 232.—Leptomeningiomas after removal by operation. Note the blunty cylindrical shape, the nodular contour, and the capsule with its blood-vessels. The scale on *Fig. 231* is in centimetres.

its consistency varies from a moderate degree of firmness in the more cellular types to extreme hardness in those specimens which have undergone extensive calcareous degeneration. A definite capsule is always present, and this has a grey or greyish-blue colour.

The size of the growth varies within wide limits; it is greatest in the cervical region and in the region of the cauda equina. One tumour in the Mayo Clinic series, occurring in the latter situation, measured 20.00 cm. in length, and reached from the level of the tenth dorsal vertebra to that of the fifth lumbar vertebra. Neuhof reports a specimen from the cervical region

in which the upper pole of the tumour was beneath the arch of the atlas, while the lower pole was at the level of the first dorsal spine. Commonly the growth is from 20 mm. to 35 mm. long, from 10 mm. to 20 mm. in its broader axis, and from 10 mm. to 15 mm. in its flattened axis.

On section the surface of the neoplasm has usually a dull greyish-white appearance (*Figs. 233, 234*). If many sand bodies are present, the knife encounters gritty material, and the surface is speckled. It is rare to note any blood. In isolated cases where the tumour is large, areas of necrosis may be found, and such degeneration may go on to the formation of cystic cavities containing a faintly blood-stained or yellowish fluid.

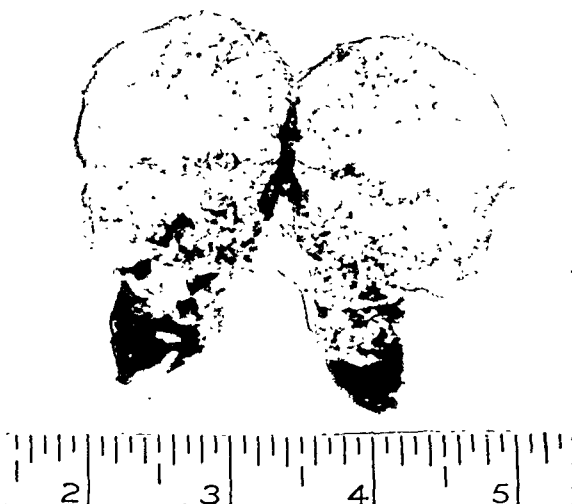


FIG. 233.—Section through leptomeningioma removed at operation. Note the hæmorrhagic cavity at the lower pole of the growth, which has a 'lobulated' appearance. The scale is in centimetres.



FIG. 234.—Section through a rather more cellular leptomeningioma. The scale is in centimetres.

In the majority of cases the outer surface of the neoplasm is adherent to the dura mater (*Fig. 235*), from whose inner surface fine strands of fibrous tissue pass to form part of the stroma of the tumour. Thus, where possible, adherent dura is removed with the growth in order to avoid leaving islands of tumour cells in the dural substance. A leptomeningioma may be so intimately attached to a nerve-root that this must be sacrificed to ensure complete removal (*Fig. 236*). Occasionally, when its origin is from the arachnoid in the region of an intervertebral foramen, the growth is so unattached elsewhere that there

is no need either to remove dura or to open the subarachnoid space (*Fig. 237*). More rarely the tumour springs from the neural surface of the

arachnoid membrane, or from the pial layer of the soft membranes: the subarachnoid space must then be opened before extirpation can be started. With the exception of the dura mater as a rule the tumour does not infiltrate surrounding structures, although in one of the cases which I observed it was so intimately applied to the cervical cord that no accurate line of demarcation could be identified at

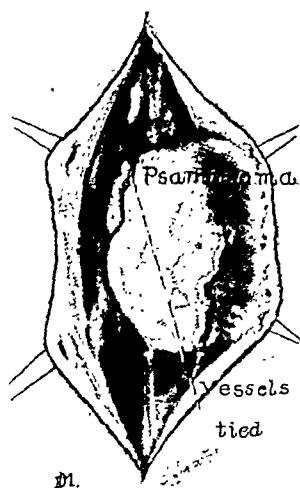


FIG. 235.—Showing, on right, adherence of tumour to dura mater, vessels from which are ramifying over the capsule of the growth.

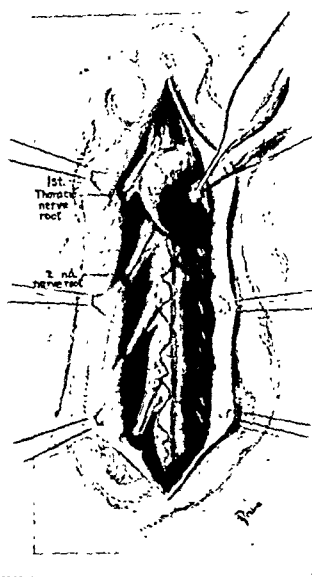


FIG. 237.—Showing general relations of a posterolateral growth. This is the commonest position of leptomeningiomas relative to the cord.

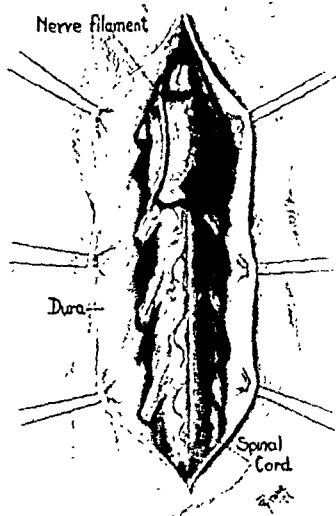


FIG. 236.—Showing intimate association of a posterior nerve-root with a dorsally situated leptomeningioma.

operation; and such a condition is not unique. The absence of infiltrative capacity shown by these tumours when occurring in the cord is a very remarkable characteristic, in view of the frequency with which cranial 'endotheliomas' not only penetrate the calvarium (thereby giving rise to hyperplastic exostoses), but also invade the muscles overlying it—for example, the temporal. Recurrence does not take place after thorough removal; in one case in

this series the patient underwent a second laminectomy at a later date:

no new tumour growth was found. I do not know of any case in which metastasis has been demonstrated, although this has been described in a case of 'endothelioma' of the brain.*

When situated high in the cervical region a tumour may extend through the foramen magnum into the posterior fossa of the skull. In these circumstances it may give rise to symptoms both of increased intracranial pressure and of pressure upon the medulla (*see* p. 434). When arising in the vicinity of an intervertebral foramen it may extend through this opening.

X. MICROSCOPIC APPEARANCES.

The following description is based upon the examination of 31 spinal leptomeningiomas removed in the Mayo Clinic. In the majority of cases a number of sections from different areas of each tumour was examined. The following stains were used: Eosin and methylene blue; hæmatoxylin (Harris) and eosin; Mallory's phosphotungstic acid hæmatoxylin; Mallory's aniline blue stain for collagen fibres; Weigert's resorcin-fuchsin stain for elastic fibres; Lugol's iodine.

Cells.—As a general rule the proper cells of a leptomeningioma are somewhat flattened, although their shape varies with the general configuration of the tumour. There is often a tendency to progressive compression and elongation, so that the cell becomes spindle-shaped (*Fig. 238*). In many specimens, and particularly in the more cellular forms, the cells are so arranged that their nuclei show the appearance known as 'palisading' (*Fig. 239*), and in such areas the earliest stages of the process of compression may be studied. Again, in the vicinity of the dura there is frequently an alveolar arrangement of the cells (*Fig. 240*), which in these circumstances are somewhat cylindrical in shape.

The nucleus is small in proportion to the amount of cytoplasm. Its shape is influenced by the degree of crowding together of the tumour tissue; rounded in the cylindrical forms of cell, it becomes oval and later elongated as the cell is compressed. While it maintains a well-defined outline it is pale



FIG. 238.—Section showing the general appearance of leptomeningioma. On the right side is a well-formed capsule. Cellular areas, whorls, and sand bodies make up the bulk of the tumour. ($\times 60$.)

* By Klebs; the secondary nodules were in the lung.

and poor in chromatin; this is arranged in very fine strands upon which may be seen several small nucleoli (*Figs. 241, 242*). Occasionally a giant cell may be found (*Fig. 243*). It is rare to observe mitosis in these tumours, although it may be demonstrated in younger more cellular specimens if the tissue has been fixed in thin slices immediately on removal.

When—as is often the case—the cells of the tumour are concentrically disposed, both cytoplasm and nucleus conform in outline to a segment of a circle. In the more cellular types demarcation between individual cells is relatively less marked, and the cytoplasm stains poorly. In older tumours the cytoplasm takes on an acid stain more readily, and is non-granular.

Stroma.—The amount of stroma present varies inversely with the cellularity of the growth, to a certain extent with its age, and with its proximity to the dura. The stroma consists of a network of fibrils of several kinds which supports blood vessels with well-developed walls. As

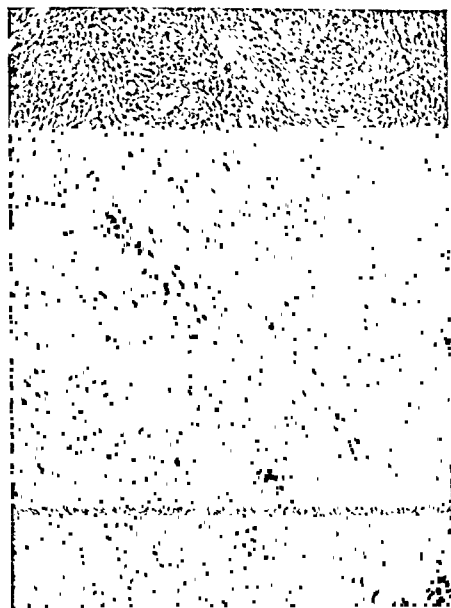


FIG. 239.—Cellular area of a leptomeningioma, showing the arrangement of the nuclei termed 'palisading'. ($\times 60$.)

will be pointed out later, it is in part the result of the activity of the tumour cells themselves, and in part may be contributed by invaded dura mater. Infiltration by mononuclear leucocytes is often a striking feature of this framework.

Fibroglia Fibrils.—These may be demonstrated by staining with Mallory's phosphotungstic acid hæmatoxylin, which imparts to them a delicate blue colour. They are produced by the activity of the tumour cells, around which they form a delicate meshwork. In course of time they coalesce and give rise to strands of more homogeneous fibrous tissue (*Fig. 244*).

Collagen Fibrils.—These occur in older parts of a tumour, and are well demonstrated by Mallory's aniline blue stain. Counterstaining with eosin is best omitted, so that the fibres appear blue on an unstained

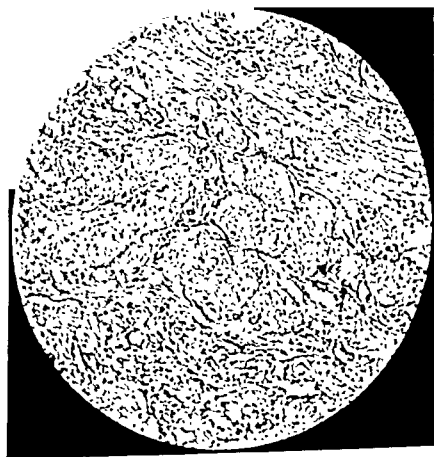


FIG. 240.—Showing alveolar arrangement of the cells of a leptomeningioma near the dura. ($\times 50$.)

background. They are disposed in a network between the tumour cells (*Fig. 245*).



FIG. 241.—A typical cellular area. Note the pale nuclei, each with one or two nucleoli. They are rounded or oval in shape. The cell outlines are indistinct because the cytoplasm stains poorly. Here and there are irregular internuclear deposits of calcium. ($\times 500$.)

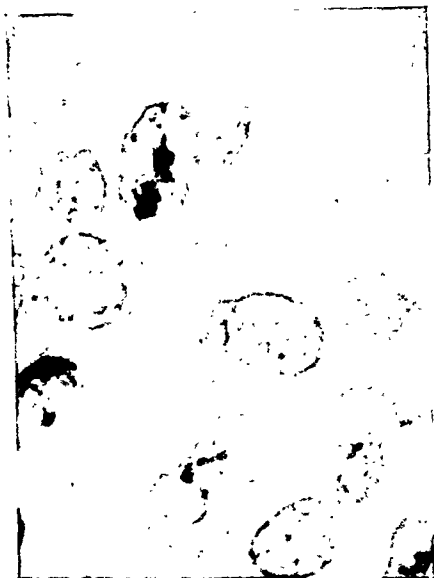


FIG. 242.—Type cells of leptomeningioma. The definite nuclear membrane gives a distinct outline to the nucleus. The scanty chromatin is arranged in a fine network, at the junctions of which it is here and there condensed to form rounded nucleoli. ($\times 1750$.)

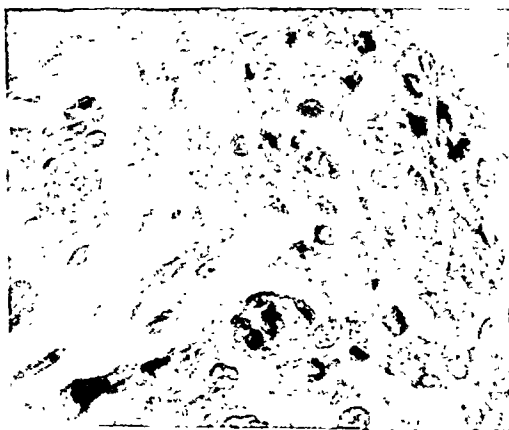


FIG. 243.—The section shows a giant cell. ($\times 400$.)

Elastic Fibrils.—These may be stained by the resorcin-fuchsin stain of Weigert. They are most abundant in areas where progressive invasion of the dura mater is taking place. As mentioned above, they may be numerous in

the partitions of dural fibrous tissue, and they are also found to a limited extent between the tumour cells in the vicinity of these strands. These fibres appear to be the result of an increase in the amount of fibrous tissue normally found in the dura. A certain number of elastic fibres are also found in cellular areas of the neoplasm distant from this membrane (*see Fig. 251*), but these are not present in all tumours.* Oftentimes a cell-whorl contains elastic fibres.

While it appears established that extracellular fibrils of this type are laid down by the neoplastic cells, a considerable portion of the completed stroma is derived from two additional sources.



FIG. 244.—Fibrils of varying thickness are seen between the tumour cells. They are fibroglia fibrils stained by Mallory's phosphotungstic acid haematoxylin stain, and brought into prominence for the purposes of the photograph by the use of a suitable coloured screen. ($\times 400$.)



FIG. 245.—Collagen fibres between the cells of a leptomeningioma. They are stained by Mallory's aniline blue stain, and brought into prominence for the purpose of the photograph by the use of a suitable coloured screen. ($\times 400$.)

1. As a result of compression of the tumour cells themselves their cytoplasm becomes condensed and hyaline, and appears to be transformed into strands and whorls of fibrous tissue. The nuclei of these cells undergo karyolysis (*Fig. 246*).

2. In the vicinity of the dura mater an infiltrating tumour is broken up by strands of adult fibrous tissue, which penetrate into its substance for varying distances. These strands are the result of hyperplasia of the dural

* I had the privilege of examining a preparation of Dr. Mallory's which showed much more elastic tissue than was present in any of the specimens at my disposal.

substance, are accompanied by blood-vessels, and oftentimes contain a considerable amount of elastic tissue (*Fig. 247*).

Cell-whorls.—The cells of a leptomeningioma show a remarkable tendency to form concentric whorls. These may be built up in a variety of ways, and are classified as cellular or fibrous.

Cellular Whorls.—The tumour cells may wrap themselves around some central cell or cells, around a

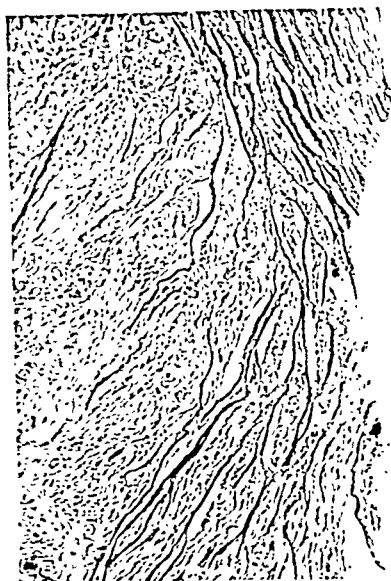


FIG. 247.—Section of a portion of tumour in the vicinity of the dura mater. Partitions of fibrous tissue directly continuous with the dural stroma pass deeply into the growth to form part of its supporting tissue. Van Gieson's stain. ($\times 60$.)



FIG. 246.—In the middle of the field is seen the process of gradual compression of tumour cells into fibrous tissue. ($\times 500$.)

blood-vessel (rarely), or around a calcareous granule. The size of the whorls thus formed varies from small collections of six or eight cells to large concentric bodies formed of many cells, but remains fairly constant for any one tumour. In the early stages of this process (*Fig. 248*) the central nuclei and cell bodies are still distinct from one another, but as the peripheral cells contract the

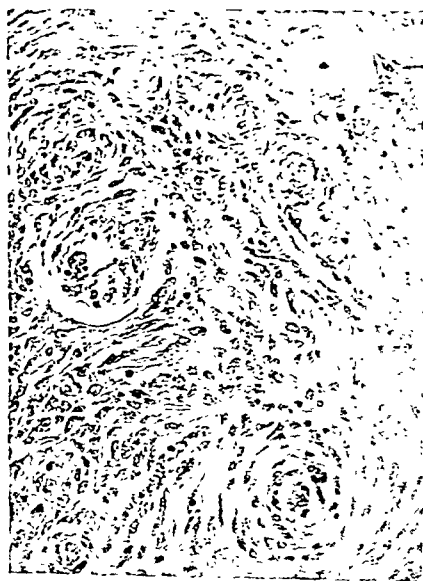


FIG. 248.—Cellular whorls. Note the concentric wrapping of the cells which produces a change in their shape: thus the nuclei are becoming elongated. ($\times 150$.)

core cells lose their outline and become more homogeneous, while their nuclei undergo karyorrhexis and later karyolysis (*Fig. 249*). The process may go on to a further stage, since the pressure of the outer cells may elongate and crush the cells of the more central layers, until the latter are directly converted into tissue indistinguishable from coarse hyaline fibrous tissue.



Fig. 249.—Cellular whorls, late stage. The nuclei which remain are much compressed, and are losing their distinctness. Many of the cells in the intermediate layers have been crushed into tissue indistinguishable from fibrous tissue. The nuclei of the cells in the outermost layers are still distinct. ($\times 150$.)

periphery to centre. Fibrous whorls oftentimes contain considerable amounts of collagen and elastic material (*Fig. 251*).

Blood-vessels.—The blood-vessels of the stroma are as a rule well supported, and especially in the neighbourhood of the dura mater may have a well-marked zone of elastic tissue in their middle coats. In older tumours not infrequently the lumen of the arteries becomes narrowed and even obliterated by hyaline degeneration of their walls (*Fig. 252*). The resulting malnutrition of the area supplied by the vessel may have a bearing upon the deposition of calcium in the tumour: though this hypothesis fails to account for the occurrence of sand bodies in the arachnoid itself—a membrane normally

Fibrous Whorls.—On the other hand, the nucleus or core of the whorl may be a strand of fibrous tissue, often dural in origin, around which the cells of the growth have disposed themselves concentrically. The core is thus amorphous from the first (*Fig. 250*). In the process of concentric wrapping the cells may include others already partly converted to fibrous tissue, so that in this type of whorl there is no regular gradation in their form from



Fig. 250.—A congeries of fibrous whorls from a tumour which consisted largely of these. Note the concentric arrangement of the fibres and the absence of nuclei from even the outermost layers. ($\times 60$.)

devoid of vascular channels (Cushing and Weed). Moreover, the rare cases of cystic degeneration in leptomeningiomas may owe their occurrence to similar vascular changes. As has been mentioned, the perivascular tissues are often infiltrated by mononuclear cells.

Degeneration in Leptomeningiomas.—

Glycogenic Degeneration.—As is demonstrable in older tissues generally throughout the body, glycogenic degeneration may appear in those cells of the tumour which are ill-nourished or old. The degenerate substance is best demonstrated by staining freshly cut frozen sections with Lugol's solution, when brownish droplets or granules may be observed in the cytoplasm of such cells.

Hyaline Degeneration.—While hyaline degeneration is common in the walls of the blood-vessels it may be observed in the fibrous tissue stroma

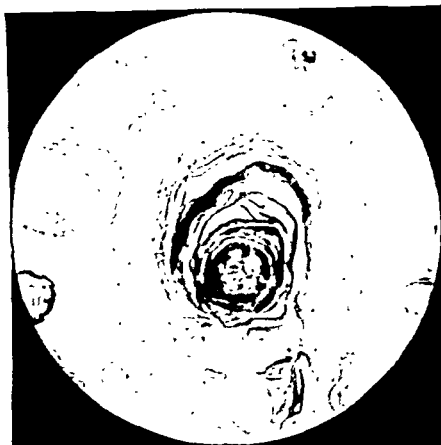


FIG. 251.—Showing fine elastic fibres in the outermost layers of a fibrous whorl. They are visible in the pale upper and outer part of the whorl as fine streaks: the broad and dense black bands are infiltrated with calcium. One or two fine elastic fibres are also visible in the triangular cellular area at the edge of the field, below the whorl. ($\times 100$.)



FIG. 252.—Hyaline degeneration in the wall of a blood-vessel in the substance of a leptomeningioma. Note the marked thickening of the vessel wall, and its homogeneous nature. ($\times 400$.)

of the tumour also, and particularly in those areas formed by a process of condensation of the cells themselves. Such tissue is somewhat refractile, and stains intensely with eosin. Hyaline change also occurs regularly in the core cells of a whorl, where it is regarded by some as a stage essential to the deposition of calcium therein.

Calcareous Degeneration.—In the great majority of older leptomeningiomas microscopic examination discloses varying degrees of calcification. From the prominence of this process in the whorls, which leads to the formation

of 'sand bodies', the term *psammoma* has been applied to this type of the neoplasm. However, calcification is not by any means confined to the whorls, and may occur widely throughout the tumour.

1. Calcareous granules may be seen in the nuclei of isolated cells, almost invariably at their periphery (*Fig. 253*), although ultimately the entire nucleus may be infiltrated. Such cells do not form part of a cell cluster.

2. Calcification also occurs in the intercellular substance and in the cytoplasm of isolated cells. The granules are usually small, and in the latter case show a marked relationship to the nuclear membrane (*Figs. 241, 256*).

3. When the whorls are affected, calcium may be deposited primarily either in the nuclei or in the hyaline intercellular substance. In the former case the first evidence of calcification is usually to be found in the form of granules situated immediately within the nuclear membrane. Thence the

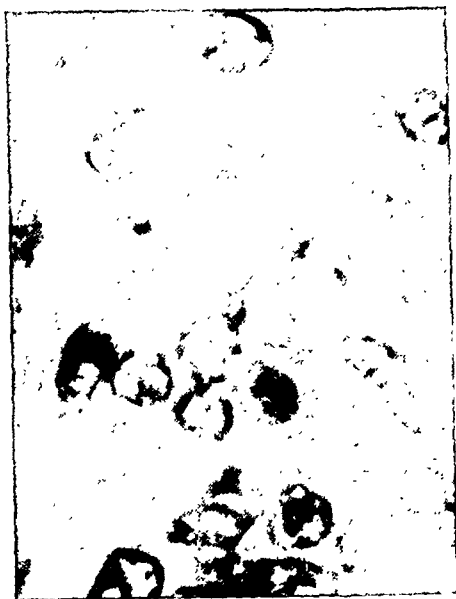


FIG. 253. — Calcification in nuclei. Darkly staining deposits of calcium are to be seen in certain of the nuclei. In most cases the granules abut upon the nuclear membrane, but in two the mineral matter shows as diffuse haze throughout the nuclear substance. ($\times 1750$.)



FIG. 254. — Calcification in the inter-substance. The deposits are irregular in shape, and finely granular. They are present both in the tumour substance generally and in the whorls. The nucleus adjacent to the large deposit in the whorl on the right appears undamaged structurally, though it is compressed. The whorls are of the cellular type. ($\times 500$.)

process extends diffusely or by the coalescence of several granules until the entire nucleus becomes calcified (*Fig. 253*). When the primary deposit is internuclear a prolonged retention of their outline by the surrounding nuclei is a remarkable feature of the picture (*Fig. 254*). Ultimately the entire whorl may become infiltrated with calcium salts. In sections stained with hæmatoxylin it then appears either as a round or nodular body of a uniform dark violet colour, or shows concentric lamination as if the mineral matter had been deposited in layers. All gradations in intensity of staining may be observed, according to the amount of calcareous matter present (*Fig. 255*). The differences are most marked in tumours containing a preponderance of

fibrous whorls; in sections stained with hæmatoxylin and eosin the appearance of these varies from a bright pink in unaffected whorls to an intense violet in the massively infiltrated sand bodies. Occasionally lighter and darker zones alternate, an appearance probably due to the occurrence of calcification in a whorl in which fibrous tissue has been irregularly enveloped by the tumour cells (*Fig. 256*).

The proportion of calcified to uncalcified tissue varies widely from tumour to tumour. Certain specimens become extensively calcified almost as fast as they grow; and this behaviour is not confined to examples occurring in older patients.* Others undergo calcification in older parts, but remain unaffected

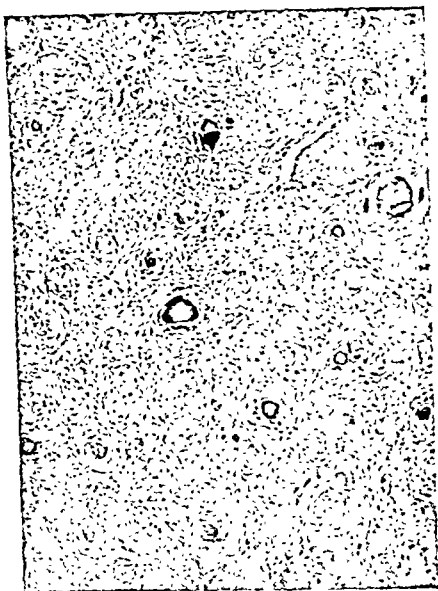


FIG. 255.—Variations in the amount of calcium deposits in cellular whorls. Note the different intensities with which the mineral matter stains in the different whorls. As a rule it is concentrically laid down, but in one or two whorls the areas of greatest density are irregular, and in a few the amount is uniformly great. ($\times 60$.)



FIG. 256.—Spinal leptomeningioma. The section shows numerous sand bodies, which have undergone varying degrees of calcification. In the majority the mineral matter has been deposited concentrically. The whorls are of the cellular type. Calcification may also be seen in parts of the tumour other than sand bodies. It is both intra- and extracellular. ($\times 120$.)

where they are growing. Still others seem to reach a certain size; then calcification begins, while the dimensions of the tumour remain stationary. The first type of growth, and the final stage of the third type, are aptly described by Bland-Sutton as 'dead' tumours. Possibly such differences are due to variations in the affinity of nuclei and cytoplasm for circulating calcium.

* The most completely calcified leptomeningioma I have seen was found post mortem in a lad, aged 22. It occupied the region of the velum interpositum.

XI. CLINICAL PHYSIOLOGY OF THE SPINAL CORD.

The nature of the initial symptoms and signs of the presence of a leptomeningioma, and their subsequent course, are so dependent upon the relation of the growth to the physiological construction of the spinal cord itself that a brief survey of this is germane to the subject (*Fig. 257*).

The pathological effects of the pressure exerted by a tumour may be described according to its position relative to the circumference of the cord. It is to be noted that since the majority of leptomeningiomas arise in the posterolateral region, symptoms referable to the function and distribution of the posterior roots are usually the first to appear. The pressure effects now to be explained are either superimposed upon, or occur subsequently to, those resulting from involvement of these structures.

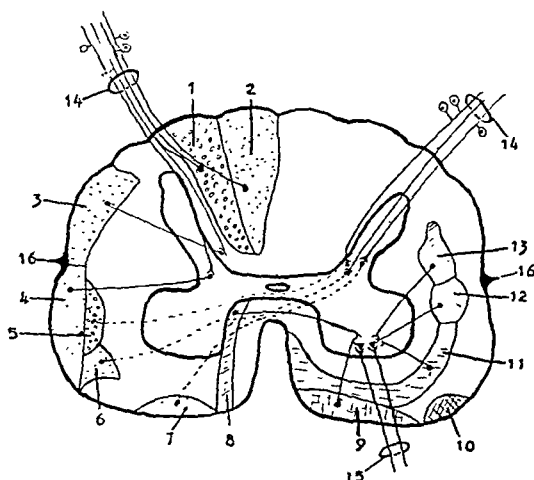


FIG. 257.—The conducting tracts of the spinal cord and their method of formation. Descending tracts on right of figure, ascending tracts on left (with direct pyramidal tract). 1. Column of Burdach; 2. Column of Goll; 3. Direct spinocerebellar tract; 4. Gower's tract; 5. Posterior spinothalamic tract; 6. Spinotectal tract; 7. Anterior spinothalamic tract; 8. Direct pyramidal tract; 9. Vestibulospinal tract; 10. Olivospinal tract; 11. Tectospinal tract; 12. Rubrospinal tract; 13. Crossed pyramidal tract; 14. Posterior nerve-roots; 15. Anterior nerve-roots; 16. Attachment of dentate ligament. (*Modified from Elliot-Smith.*)

Posterior Tumours.—These press first upon the conducting fibres in the columns of Goll and Burdach. These are formed from the centripetal parts of axones of bipolar cells in the spinal ganglia. After entering the cord, such a fibre divides into a long ascending branch, and a much shorter descending branch. The latter after a short course ends round a nerve-cell in the grey matter. The former passes upward on the homolateral side of the cord, and either ends at a higher level like the descending branch, or is continued to one of the nuclei in the medulla, whence its message is carried by a fresh neurone to the optic thalamus

of the contralateral side; thence a third uncrossed neurone transmits the impulse to the cortex of the post-Rolandic area. Thus impulses carried by a certain proportion of these fibres rise into consciousness.

They are concerned with the transmission of the following types of sensation: (1) That part of tactile sensation which deals with the recognition of two separate points of contact. (2) Impulses from muscles and tendons communicating the degree of tension present in them. On these impulses depends the ability to appreciate differences in weight. (3) Impulses from articulations, communicating their position. (4) Impulses communicating the sensation of vibration.

Changes in their conductivity result in the following symptoms and signs

in areas of the same side supplied from below the level of the lesion: (1) Diminution or loss of appreciation of the compass test. (2 and 3) Inco-ordination in purposive movements of the limbs, usually ascribed to muscular weakness by the patient, including disturbances of gait of an ataxic type; astereognosis; loss of ability to appreciate differences of weight. (4) Diminution or loss of appreciation of a vibrating body.

Posterolateral Tumours.—These implicate the spinocerebellar tracts, posterior (or direct) and anterior (or Gower's tract). Both are composed of the axones of cells in the grey matter of the homolateral side, around which certain of the posterior root fibres of the same side have formed synapses. Both are destined to end in the vermis of the cerebellum, the former passing thither by way of the restiform body, the latter by way of the superior peduncle. Their function may be defined as the carriage of afferent impulses from the tissues under the skin, especially muscles and tendons; impulses which never rise into consciousness, but which are essential to the cerebellum for its task of maintaining muscular co-ordination and tone.

Interruption of these tracts therefore gives rise to varying degrees of inco-ordination in areas on the same side innervated by segments below the level of the lesion.

Anterolateral Tumours.—These may affect the conductivity of Gower's tract, with the clinical result set forth above; and at the same time, from implication of the more posterior of the anterior nerve-roots, there may occur certain associated signs referred to in the following paragraph.

Anterior Tumours.—These press upon the anterior nerve-roots. The resulting signs are found on the homolateral side, and are referable to the affected segment of the cord; at first irritative in character, they ultimately progress to muscular palsy and atrophy, and will be dealt with fully when the 'root cycle' is considered (p. 431).

All Tumours.—If not removed early, all tumours ultimately affect the more deeply situated tracts of the cord. For practical purposes these may be grouped thus: (1) *Ascending tracts* conveying impressions of pain, temperature, touch (except the discrimination of two points), and visceral sensation; (2) *Descending tracts*: (a) The *cerebrospinal tracts*, crossed and uncrossed; (b) Other descending tracts (*rubrospinal*, *vestibulospinal*, *tectospinal*) concerned in the maintenance of muscular co-ordination and tone, and visceral efferent tracts.

1. **ASCENDING TRACTS.**—These are formed of the axones of cells in the grey matter of the contralateral posterior horn, around which have ended fibres of the contralateral posterior nerve-roots. These axones are so regrouped that sensations of pain and temperature are conveyed in the *posterior spinothalamic tract*, while sensations of touch (less tactile discrimination) and sensations of deep pressure are conveyed in the *anterior spinothalamic tract*. However, there is an important difference in the method of rearrangement of the two sets of fibres: both cross the cord obliquely, but the latter cross much more obliquely than the former. Purves-Stewart summarizes the matter thus: "There is no crossing of the fibres below the second lumbar segment. In the mid-dorsal region pain and temperature fibres cross quickly, and decussation is complete within one segment above the point of entry of the original posterior nerve

roots through which they entered the cord, whereas touch fibres cross more slowly, and are completely crossed in two segments. . . . In the upper dorsal region pain and temperature have crossed in two segments, and touch in three, whilst in the cervical enlargement the former cross in four segments, the latter in five. Finally in the upper cervical region pain and temperature ascend for five or six segments before they all reach the opposite side". This second neurone ends in the optic thalamus, whence uncrossed fibres continue the path to the post-Rolandic cortex.

Pressure upon these ascending tracts therefore leads to diminution or loss of appreciation of tactile (partially), thermal, and painful stimuli applied to the contralateral side in areas supplied by nerves arising below the level of the lesion. The probable path pursued by visceral afferent fibres will be indicated later.

2. DESCENDING TRACTS.—

a. Cerebrospinal Tracts.—These control the homolateral (crossed) and contralateral (uncrossed) sides of the cord, so that pressure upon them causes a diminution or loss of the ability to perform voluntary movements, below the level corresponding to the segment of the cord implicated. Since cerebral impulses regulating the degree of muscular tone also travel by way of these tracts, the paralysis is of the spastic type. In the upper three cervical segments, where these fasciculi are situated at or near the anterior surface of the cord, signs of pressure upon them may be the first and even the only indication of the presence of an extramedullary tumour.

b. Other Descending Tracts.—Lesions of the remaining descending tracts deprive the homolateral muscles supplied from below the level of the lesion of the co-ordinating impulses derived from the cerebellum (rubrospinal), visual apparatus (tectospinal), and semicircular canals (vestibulospinal). There follows also a loss of the tonic influences which they exercise.

In using such a brief summary of the conducting functions of the spinal cord to correlate clinical data, two most important qualifications must be borne in mind:—

1. Since the fibre tracts are not clearly demarcated, the signs and symptoms will almost always be those of involvement of several fasciculi. Moreover, while it is true that the effects of extramedullary pressure fall most severely upon tissue in the immediate vicinity of the growth, yet the pathological process is such that the more deeply situated bundles are also affected, albeit to a less extent.

2. Signs due to pressure on any part of the circumference of the cord may be accompanied by signs of pressure upon that area of the cord diametrically opposite to the original pressure point. In the succeeding section attention will be drawn to the mechanical factors underlying such a clinical picture (p. 428).

The Sympathetic System.—Clinical evidence of the interruption of tracts conveying sympathetic impulses may be found in variations in visceral sensibility, in the amount of cutaneous vasodilatation present, and in the amount of sweating.

Such fibres leave the cord from the eighth cervical to the second lumbar segment, both inclusive. They are said to be distributed as follows:—

Eighth cervical to third dorsal—all the body above that part of the thorax innervated by the cervical plexus.
 Fourth dorsal to seventh dorsal—arms.
 Eighth dorsal and ninth dorsal—trunk.
 Tenth dorsal to second lumbar—legs.

Unilateral compression of the cord at or above the eighth cervical segment may therefore affect the whole homolateral side of the body, although the sensory loss is much less. At about the ninth or tenth dorsal segment the sympathetic and sensory levels coincide, while below this level the former is never so high as the latter.

The innervation of the bladder and rectum is so complicated that its consideration is best deferred until disturbances of these viscera are discussed.

XII. PATHOLOGY OF COMPRESSION OF THE SPINAL CORD.

The appearances due to compression of the spinal cord and the manner in which they are brought about have been exhaustively presented by Stewart and Riddoch, upon whose paper the following account is largely based. These observers emphasize the importance of the changes in the vascular supply of the cord produced by the compressing body. The lymphatic spaces around the segmental nerve-roots and blood-vessels communicate with the interpal lymph space, situated between the inner circular and outer longitudinal fibres of the pia mater. The interpal lymph space in its turn communicates with the lymph spaces of the cord, which are arranged in three groups (*Fig. 258*): (1) The *pericellular* lymph spaces, communicating with (2) The *perivascular* lymph spaces; (3) The *adventitial* lymph spaces, situated between the inner or middle coat of the vessels and their outer coat.

The anterior spinal artery supplies the grey matter, and the two posterior spinal arteries the white matter of the cord. All are end arteries. If any one of these arteries is occluded by the pressure of the tumour or by thrombosis, the resulting damage to the nervous tissue of the cord is confined to the area supplied by the penetrating branches leaving the artery at the level involved. Below that level the circulation is maintained by anastomotic vessels derived from the intercostal, subcostal, and lumbar arteries, which reach the cord through



FIG. 258.—The section shows the intercommunication between the perivascular spaces of the vessels of the subarachnoid space, pia, and cord on the one hand, and the interpal space on the other hand, ($\times 350$.)

the intervertebral foramina. In the spinal veins the flow of blood is from below upward, and the collateral channels are few in number; therefore the veins below a growth are commonly found distended. This distention is an important contributory factor to the changes found in the cerebro-spinal fluid below the block; and, moreover, may possibly cause nervous symptoms referable to a segment below the tumour, not only as an effect of the venous stasis upon the nervous tissue, but also from the pressure exerted by the engorged vessels.



FIG. 259.—The meninges at the level of compression. The dura is thickened, as are also the walls of the blood-vessels. The perivascular tissue is infiltrated by small round cells. ($\times 90$.)

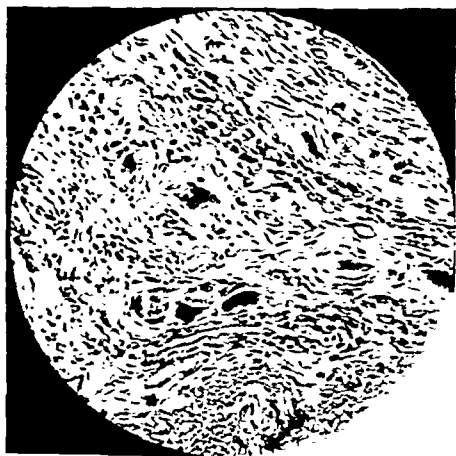


FIG. 260.—From a case of cervical leptomeningioma. Foreign body giant cells in the thickened spinal membranes at the level of the tumour. ($\times 100$.)



FIG. 261.—Giant cell in the meshes of the arachnoid at the level of compression. It is of the foreign body type, and is in process of ingesting round cells and pigment granules. ($\times 400$.)

The microscopic changes—surprisingly few save when the compression is of long standing—are grouped by Stewart and Riddoch under three heads: (1) *At the site of compression*; (2) *Below the site of compression*; (3) *Above the site of compression*.

1. At the Site of Compression.—

a. The spinal membranes are thickened, and the arachnoid contains giant cells engaged in the ingestion of blood-pigment (*Figs. 259-261*).

b. The endothelial cells lining the perivascular spaces are œdematous, and the lumen of the space contains small round cells and granules, sometimes



FIG. 262.—From a case of cervical leptomeningioma. Round cells in the Virchow-Robin space of a cord vessel, and also in the interstitial lymph space. ($\times 50$.)

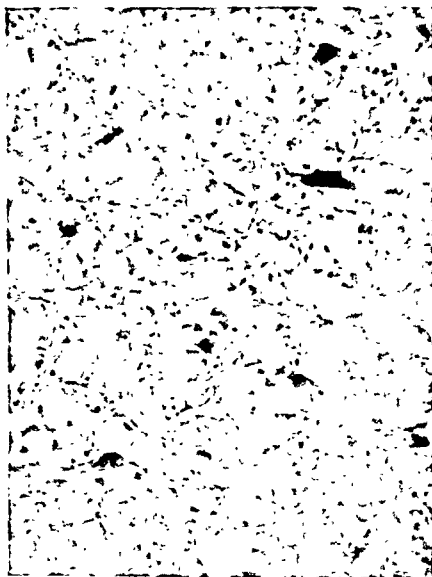


FIG. 264.—Gliosis in the posterior columns of the cord at the point of compression. ($\times 400$.)



FIG. 263.—Round cells and granules in the interstitial space at the level of compression of the cord. ($\times 400$.)

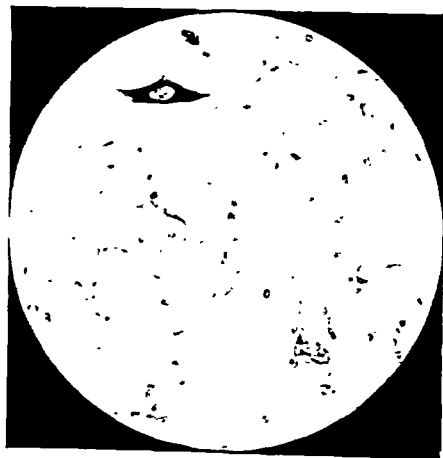


FIG. 265.—Motor cells from the anterior horn of the spinal cord of a dog, at the level of compression. The upper cell is unaffected, but the lower cell has lost most of its Nissl granules, and the nucleus is undergoing karyolysis. Methylene blue stain. ($\times 100$.)

in such quantity as to obliterate the adventitial lymph space (Virchow-Robin space). (Figs. 262, 263.)

c. The nervous elements of the cord are separated by the proliferation of neuroglia, so that the section has a spongy appearance (*Fig. 264*).

d. In advanced cases there is necrosis of such areas of the cord as were supplied by arteries which have been occluded.

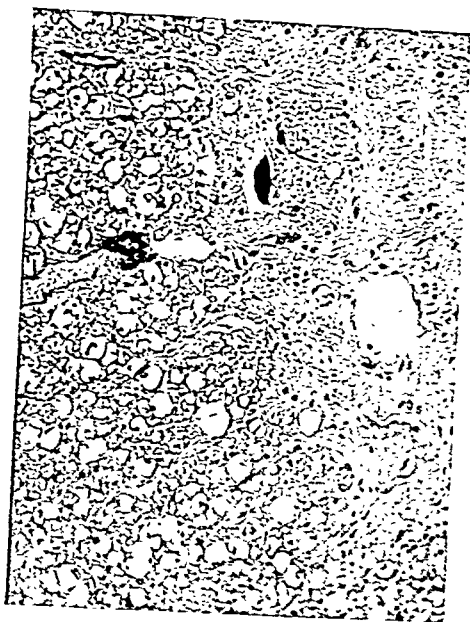


FIG. 266.—The section passes below the level of the compression and shows great distention of the blood-vessels of both grey and white matter, due to obstruction of the spinal veins. ($\times 150$.)

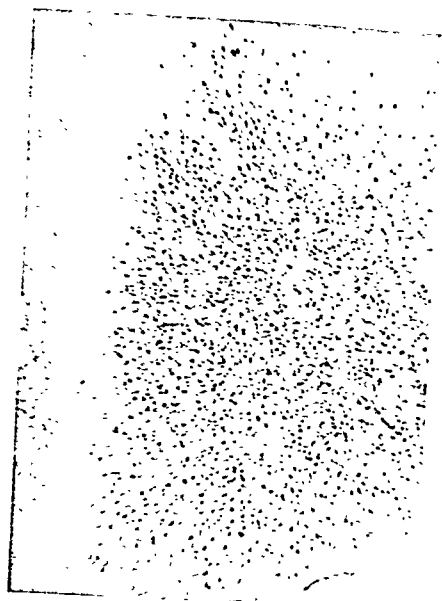


FIG. 267.—Cord from dorsal region in a case of leptomeningioma of the cervical region. Stained by Marchi's method. Note the degenerating fibres in the posterior column. ($\times 25$.)



FIG. 268.—Early descending degeneration in spinal cord of dog, below point of compression. Although there was complete analgesia and partial paraplegia below the level of the tenth dorsal segment, degeneration is scanty and apparently selective. Weigert stain. ($\times 10$.)

e. In the grey matter histological changes are first seen in the cells nearest the point of compression. They are swollen and their nuclei eccentric. Later the nuclei lose their chromatin, and Nissl granules are no longer demonstrable (*Fig. 265*).

f. In the white matter the severity of the process is again greatest in the area nearest the tumour. The neuroglia proliferates, many of the axis cylinders are destroyed, and the myelin sheaths are swollen.

2. Below the Site of Compression.—

a. The veins are engorged and dilated. Their walls, and the walls of the arteries, are thickened (*Fig. 266*).



FIG. 266.—From a case of cervical leptomeningioma. Cervical cord immediately below tumour, showing unilateral descending degeneration. Weigert stain. ($\times 5$.)

b. The lumen of the perivascular spaces does not contain small round cells or granules. Around the vessels of the cord there may be some proliferation of neuroglia.

c. Descending degeneration in the fibre tracts is scanty save in late cases, and out of all proportion to the clinical features (*Figs. 267–270*).

3. Above the Site of Compression.—

a. There is isolated degeneration of a few ascending fibres.

In the absence of sufficient degeneration in the fibre tracts to account for clinical symptoms, the only possible explanation of the latter is that the interruption is not an anatomical one, since the conducting paths may resume their function if the tumour is removed at a sufficiently early stage. According to Stewart and Riddoch, recovery of the conducting system is possible even after the fibres have lost their myelin sheaths; and function may return to motor cells in the anterior horns after they have become swollen and their nuclei excentric. The interruption is due: (1) To the pressure of the swollen blood-vessels upon the nervous elements; (2) To the pressure exerted by the exudate from the intramedullary blood-vessels

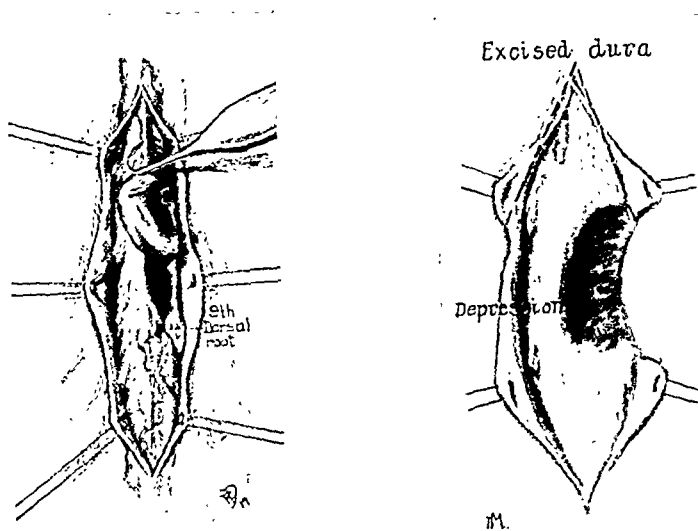


FIG. 270.—From a case of cervical leptomeningioma. Dorsal region of cord, showing advanced bilateral descending degeneration in the lateral columns. On the one side this has been produced by the pressure of the tumour, on the other by pressure of the cord against the opposite bony wall. Weigert stain. ($\times 5$.)

and lymphatics; (3) To malnutrition and deficient oxygenation of the tissues, partly because of the decreased permeability of the vessel walls, and partly because of the chronic congestion.

Where the pressure is long-continued the motor cells in the grey matter are the first permanently to lose their function. Where an artery has become blocked, permanent loss of function may also occur in its area of distribution.

The degree of compression of the cord varies; in one case in the present series, after removal of the tumour the cord was found to be one-sixth of its normal size. Post-operative recovery of function is more likely when the cord has been flattened gradually over a considerable length than when it has been indented deeply by a circumscribed growth (*Figs. 271, 272*).



FIGS. 271, 272.—Showing depressions in the cord produced by leptomeningiomas.

Mechanical Factors in Compression of the Cord.—Naturally the levels of the cord most sensitive to increases in extramedullary pressure are those where it cannot yield before the advancing tumour—that is, where it is fixed by the attachments of the dentate ligament to the dura mater. It follows that the levels of its greatest possible excursion are the points of origin of the segmental nerve-roots. The varying calibre of the spinal canal may also affect the rate at which symptoms develop; thus while relatively roomy in the cervical and lumbar regions, it is less so in the dorsal region. As pointed out by Elsberg and Stookey, mechanical factors may explain the cases of 'reversed Brown-Séquard syndrome' which occasionally occur (*Fig. 270*, and see p. 432). If the tumour is adherent to pia mater, the side of the cord opposite to it is, if the level permits, pushed against the adjacent bony wall; in the absence of such attachment the cerebrospinal fluid forms a cushion between the tumour and the cord, before which the latter is pressed against the bone or ligament opposite. As Elsberg and Stookey admit, the second

of these two explanations is difficult to reconcile with the laws of fluid pressure; yet some such process must be postulated to account for the clinical features. These hypotheses are supported by the observation that in certain cases the withdrawal of cerebrospinal fluid from that portion of the sub-arachnoid space below the tumour may lead to variations in the intensity and even in the level of the clinical signs. In such cases the removal of the buffer previously provided by the fluid permits the tumour to exercise the greatest pressure of which it is capable.

XIII. CLINICAL FEATURES.

The following description of the clinical features of cases of leptomeningioma of the cord is based upon a study of the case records of 31 patients treated at the Mayo Clinic, and 29 reported in the literature since the year 1918. Five of the former came under my personal observation, through the courtesy of Drs. W. D. Sheldon and A. W. Adson, of the Neurological Department, and are described in full on pp. 462-469.

It has been customary to divide the course of the disease into three periods or 'cycles': (1) The root cycle; (2) The Brown-Séquard syndrome; (3) Complete paraplegia with urinary and rectal incontinence. While this is useful for descriptive purposes, it has the effect—common to all such artificial divisions—of obscuring the essential continuity of the manifestations of the disease. I prefer to regard its clinical features from the point of view of the pathological physiology and anatomy of the parts affected. While the majority of patients will probably first seek medical advice during the so-called root cycle, the nature of the pain from which they suffer is unfortunately rarely recognized at this stage. When the final diagnosis is made the patient shows features of both second and third periods, the diagnostic value of which can be appreciated only by a proper understanding of the processes concerned in their production. Moreover, since the symptoms vary according to the relation of the tumour to the spinal cord, no one description is applicable to all growths. That which follows will not be subdivided in any way.

There is wide variation in the duration of symptoms and signs from their onset until operation. In many cases such delay in exploring the cord is avoidable; in a very few, difficulties in determining the exact level of the growth force the clinician to wait until the course of the malady provides him with more complete information upon which to base his diagnosis. In the present series the average duration of the disease was 30.8 months; the shortest history given was 1.5 months (one case), and the longest 84 months (four cases).

The first symptom complained of is usually *pain*. In but six cases of the present series (10.0 per cent) was pain absent during the whole course of the disease. Three of these patients had anterolateral tumours, whose presence does not necessarily give rise to pain, while three suffered from posterolateral growths of small size, probably situated between two adjacent bundles of posterior nerve-roots. Pain is almost always due to pressure upon posterior nerve-roots, and since at the beginning only a few fibres are involved by the neoplasm it is often at first strictly localized to one place on the

surface of the body. Later, as more and more fibres become involved, the pain radiates along the nerves joined by the affected roots. It is at first unilateral, but may become bilateral where the tumour is extensive, or where the opposite posterior root is pressed against the bony wall of the spinal canal; and strictly dorsal growths may give rise to bilateral pain from the first. The pain is described in a variety of terms: aching, drawing, sharp, dull, gnawing, tight, cramping, stinging, and pricking. Sometimes it is continuous, sometimes it occurs in almost unbearable paroxysms, which may be separated by intervals of complete freedom. An attack may be precipitated or intensified by any sudden jarring movement, especially of the spine, or by coughing or sneezing; all these factors alter the relation between growth and fibres, the last two by causing a momentary increase in the fluid pressure in the subarachnoid space. Pain is often worst when the patient is recumbent, and is relieved by the assumption of an erect position. Thus a history may be given that the patient is awakened by pain after a few hours of sleep, and can obtain relief only by getting up and walking about; indeed, many discover for themselves that they pass the night most comfortably by sleeping in a sitting posture in a chair.*

At this stage it may be discovered that one spinous process is acutely tender; this belongs to the vertebra innervated by the segment opposite which the tumour is growing. More rarely it is possible to demonstrate some rigidity of the bony spine immediately over the tumour, a sign which results from direct irritation by the growing neoplasm. Root pain disappears as the disease progresses, when the synapse between root-fibre and nerve-cell of the second neurone becomes functionally paralysed, or when the conductivity of the second neurone is interrupted. Later in the disease there may develop pain which has a bizarre distribution. It is more than likely that this is the result of pressure upon the ascending tracts, a point which will be discussed later (p. 436).

While root pain is present, and even sooner, paræsthesiæ may be felt in the skin area supplied by the irritated roots over a period which may last for years. Occasionally a ventrolateral tumour first discloses its presence by giving rise to contralateral paræsthesiæ. In such a case the growth presses the opposite side of the cord against the wall of the canal, and in this way sensory tracts are irritated before their individual fibres have crossed the cord. The feeling most often complained of is numbness and coldness, but others, such as formication, burning, tingling, a sensation as of wool upon the skin, may occur. As a rule paræsthesiæ are of more uniform intensity and are more constantly present than is pain; but there is no sharp dividing

* The explanation of this fact is by no means simple; three factors may be concerned: (1) The weight of the cord itself may tend to slacken the posterior nerve-roots as they pass downward to the intervertebral foramina. (2) The spinal column is longer in the recumbent position than it is in the erect. The increase is due to expansion of the intervertebral discs when freed from their task of transmitting the weight of the body to the pelvis. Nerve-roots are therefore under less tension in the erect position. (3) Dr. A. W. Adson has pointed out to me that there is probably an increase in the fluid pressure in the subarachnoid space during sleep. Thus the headache of intracranial tumour often begins in the early hours of the morning, and a cranial decompression, adequate during the day, may be found tense and bulging after the night. Possibly all three factors are contributory.

line between, for example, a mild burning sensation, and a similar but more intense sensation which is interpreted as painful.

While pain and paræsthesiæ are possibly the only symptoms present, sensory changes may be detected over the area supplied by the affected roots. Diminution in response and over-reaction to stimuli of touch, pain, and temperature may all be present in the skin territory of the affected fibres. The terms 'hyperæsthetic' and 'hyperalgesic' commonly applied to such areas are erroneous, in so far as they describe the condition of only some of the receptors in the area; "within this area there may be defective appreciation of pinprick, but the sensation produced by the latter when the stimulus is effective is abnormally disagreeable. It is better therefore to speak of this as an area of 'over-reaction' rather than 'hyperalgesia'". (Medical Research Council: *Injuries of the Spinal Cord and Cauda Equina*. Special Report Series, No. 88.)

A growth which presses upon the anterior root-fibres discloses its presence by giving rise to disturbances of function of the voluntary muscles which they supply. During the stage of irritation muscular tremors are observed, and occasionally clonic spasms which may be so intense as to be painful. When the nerve-fibres are completely interrupted there occurs a flaccid paralysis of the muscle-fibres which they supply; but before the whole of any one muscle becomes paralysed, the conductivity of all anterior nerve-roots arising from the three adjacent cord segments which supply it must be destroyed. Such a condition is characterized by progressive atrophy of the muscle; at first by the presence of the electrical reaction of degeneration, and later by loss of response to both galvanic and faradic currents; and by the abolition of any reflex which the paralysed muscle may subserve.

As has been emphasized, there may be associated with these features evidence of pressure upon the conducting tracts of the cord, and this has been detailed in a previous section (p. 420). As the tumour grows it gradually affects the more deeply situated bundles until all or nearly all of the conducting systems on the homolateral side of the cord are interrupted. A progressive paralysis of the muscles on the homolateral side of the body innervated by segments of the cord below the point of compression now ensues, and this is of the spastic type. The period which elapses before signs of motor weakness appear is variable; as has been stated, ataxia is often mistaken by the patient for weakness of the affected limb. *Table VII* shows the number of cases in which 'weakness' was an initial symptom (see, however, p. 421).

Table VII.—NUMBER OF CASES IN WHICH 'WEAKNESS' WAS AN INITIAL SYMPTOM.

SITUATION OF TUMOUR			TOTAL	'WEAKNESS,' FIRST SYMPTOM IN
Anterior	..	..	1	1
Anterolateral	..	..	11	1
Posterolateral	..	..	38	8
Posterior	..	..	7	2

Finally, when the conductivity of one half of the spinal cord is largely interrupted, the patient presents a clinical picture known as the *Brown-Séquard*

syndrome. Reference to the section on CLINICAL PHYSIOLOGY will show that the results of such a unilateral lesion will be the following:—

1. On the Homolateral Side, in Areas Supplied from Below the Level of the Lesion.—

- a. Spastic paralysis of the muscles, with exaggeration of the reflexes in which they are concerned (see, however, p. 431).
- b. Loss of appreciation of the compass test.
- c. Astereognosis, and loss of the power of appreciating passive movements and of comparing weights.
- d. Loss of appreciation of vibration.

2. On the Contralateral Side, in Areas Supplied from Below the Level of the Lesion.—

Loss of appreciation of painful, thermal, and tactile (less compass test) stimuli. On account of the varying obliquity with which these fibres cross the cord, such sensory loss will never extend quite so high as the level supplied by the segment involved. Moreover, the level of tactile loss will be lowest, since fibres conveying this sensation cross the cord more obliquely than those conveying sensations of pain and temperature; and such tactile loss is only partial.

Sometimes the area of skin on the homolateral side which is supplied by the nerve-roots arising at the level of the tumour is found to be completely insensitive to all forms of stimuli. In the thorax this area is in the form of a band. Since the researches of Sherrington have shown that complete sensory loss occurs only after the destruction of all the roots arising from the three contiguous segments which are concerned in the innervation of any one area of skin, such a finding postulates the presence of a tumour of sufficient vertical extent to produce this destruction. In addition to this totally insensitive area a zone of over-reaction, usually bilateral, is commonly present at a level which corresponds to the segment of the cord immediately above that compressed by the growth; this zone is due to irritation of posterior nerve-roots by the upper part of the tumour, and possibly by distended blood-vessels and a cerebrospinal fluid under increased pressure.

I have been unable to correlate the position of the tumour with the degree of loss of each of the types of sensation. Most frequently tactile sensation is less affected than the other forms, and this finding is due to the greater number of paths by which impulses conveying sensations of touch may travel in the cord. Rarely—as in two cases in this series—tactile sensation may be preserved when there is complete analgesia and thermanæsthesia. The deep-pressure sense and that of position of joints are often retained until a late stage of the disease, although in isolated cases the latter may be impaired singly. Selective interference with afferent impulses is more often a feature of intramedullary growths.

If operation is undertaken in the presence of evidence of unilateral compression, it is occasionally found that the sensory loss has been on the same side as the tumour, while the earliest motor palsy has appeared on the contralateral side. This group of symptoms and signs is known as the '*reversed Brown-Séquard syndrome*'. It has been explained on mechanical grounds as

the result of displacement of the cord against the bony wall of the spinal canal on the side opposite to the growth.

As the interruption of the cord progressively involves the contralateral side, spastic paralyses appear on this also, and sensory changes are found on the homolateral side. At this stage examination shows sensory loss which varies somewhat with the relation of the growth to the cord, although in late cases it is relatively easy to map out the upper level of the defect. When the sensory loss is at all profound, sphincteric disturbances are present in from one-third to one-half of the cases (p. 440). As the paralysis deepens, the posture of the limbs, and especially of the lower limbs, assumes one of the two forms to which attention was originally directed by Babinski: 'paralysis in extension' and 'paralysis in flexion'.

Paralysis in Extension.—This occurs when the great corticospinal motor tracts alone are damaged. The increase in tonus affects extensors and flexors equally. It is possible for this type of paralysis to occur in cases of leptomeningia, although it is more characteristic of hemiplegia and primary lateral sclerosis. But when a tumour is situated on the ventral aspect of the cord at the level of the highest cervical segments, its pressure falls first and most severely upon the pyramidal tracts, here situated on the surface. In this condition the arm is flexed and pronated, the leg extended at the hip and the knee, the foot plantar-flexed and the toes dorsiflexed. The spasticity is increased by efforts at movement, but is diminished during sleep, when the tonic centres in the mid-brain are not stimulated to activity by a constant centripetal stream of external impressions.

Paralysis in Flexion.—This is the usual posture assumed by the limbs of patients suffering from such extramedullary growths. In these cases the pressure affects not only the pyramidal but also the extrapyramidal tracts; the loss of the tonic influence of the latter principally affects the extensor group of muscles, while the flexor group maintains a considerable degree of tone. The hip and knee are flexed, the ankle is dorsiflexed. Extreme activity of the reflexes of defence is the characteristic feature of this type of paralysis; the tendon-jerks subserved by extensor muscles may be greatly diminished or lost (knee-jerk, ankle-jerk), although such a reflex as the hamstring-jerk is increased. The degree of flexion is from time to time increased by involuntary and sometimes painful spasmodic contractions of the flexor muscles.

Occasionally the degree of spasticity is so extreme that the term *hyper-spastic* is applied to the paralysis (Mouzon). This may be either in flexion or extension; the rigidity persists during sleep, and spontaneous painful spasms are frequent.*

In the most severe cases of compression of the cord, the paralysed muscles pass through a spastic stage to a final stage of flaccidity. Voluntary movement is impossible, and no skin- or tendon-reflexes can be obtained in the

* A short explanation of these differences in tonus may be germane to the subject. There are two great reflex systems: (1) The extensor, which maintains a steady tonus and is postural in type. This tonus is said to be controlled by a distinct subcortical descending tract which originates in the mid-brain. (2) The flexor, which is a pure spinal reflex and phasic in type. It is unaffected by severance of the cord from the brain, and is 'prepotent'—that is, it may replace the tonic extensor reflex.

extremities. Such a state is generally held to be proof of irrecoverable damage to the nervous tissue of the cord, but in one case in this series the patient recovered some motor power after removal of the tumour. In this case laminectomy was performed eight months after the onset of symptoms, when the patient had complete flaccid palsy of both legs. A growth at the level of the ninth dorsal vertebra had compressed the cord to half its normal size. It was completely removed, and two months after operation muscular power had returned almost entirely.

In the final stages of the disease the patient is, of course, completely bed-ridden. Paralysis and sensory loss are absolute below the level of the growth, and the evacuations are passed involuntarily. Moreover, his condition is intensified by the appearance of trophic disturbances. The insensitive skin is smooth and shiny, and the subcutaneous tissues may be œdematous. Trophic ulcers form, and the most extreme care is required to prevent the occurrence of bed-sores upon such projecting parts as the sacrum and great trochanters. Vasomotor disturbances such as are met with in Raynaud's disease or erythromelalgia may appear. There may be either profuse sweating or anidrosis of the parts; this question will be discussed when the localizing value of sudomotor reflexes is considered. Such patients are very subject to infection of the genito-urinary system, and indeed a common cause of death in untreated cases is severe pyelonephritis, secondary to the cystitis which it is almost impossible to prevent. Intercurrent respiratory infections carry off other patients, whose condition of inanition makes such a complication almost always fatal. Organisms from infected bed-sores may reach the general circulation, and even, by direct extension, the subarachnoid space. Still other sufferers die of exhaustion, worn out by pain and lack of sleep.

XIV. LEPTOMENINGIOMAS IN SPECIAL SITUATIONS.

Cervical Region.—Tumours of the upper part of the cervical region present many interesting features. Large specimens may extend through the foramen magnum into the posterior fossa of the skull, in dangerous proximity to the medulla oblongata and the last four cranial nerves. Thus in a case reported by Frazier and Spiller there was atrophy of one side of the tongue, and after operation the patient died of respiratory failure, doubtless due to paralysis of the respiratory centre in the bulb as a result of post-operative œdema. Respiratory difficulty prior to operation may occur from paralysis of the diaphragm (phrenic nerve) and the accessory muscles of respiration. Sometimes difficulty in swallowing and dysarthria are present. From implication of the posterior root of the second cervical nerve severe headache may be felt throughout the distribution of the great occipital nerve, and pressure on the upper cervical anterior roots may lead to atrophy of the nuchal muscles on one side. A full report upon a patient with such a tumour who came under my observation is presented on p. 462. It may be mentioned here that this patient had vomiting which was not associated with nausea; however, there was no papilloedema.

When the level of the tumour is such as to cause spastic paralysis of the arms, an interesting condition known to the ancients as *pandiculation* may be

observed. Here the act of yawning is accompanied by involuntary movements of the arms and fingers similar to the voluntary movements often performed with this act, termed 'stretching'. According to Purves-Stewart, "these movements are due to uncontrolled activity of the striato-spinal system. In other words, they are released postural reactions in muscles deprived of voluntary control, and the more severe the lesion of the pyramidal tract, the more marked is the pandiculation". Pandiculation was an interesting feature of the case mentioned in the preceding paragraph. When the growth is in the region of the lowest four cervical segments, there may be flaccid palsy of one arm. Usually the sequence of paralysis is: (1) Homolateral arm; (2) Homolateral leg; (3) Contralateral leg; (4) Contralateral arm—an order which affords evidence of grouping of the fibres in the pyramidal tract according to their distribution. In a few cases the contralateral side is first affected, as a result of pressure of the cord on the opposite bony wall.

As one manifestation of disturbed sympathetic innervation, tumours of the cervical cord may give rise to differences in the size of the pupils. In common with other associated phenomena, this is due to pressure upon visceral efferent pathways in the lateral columns of the cord; sympathetic fibres do not leave the cord until these tracts reach the eighth cervical segment.

Occasionally growths in this region give rise to false localizing signs. Thus at first they may cause sensory and motor symptoms referable to the lower extremities. These are the result of pressure upon both afferent and efferent conducting tracts, and it would appear that the fibres serving the extremities, and even parts of the extremities, are gathered into groups in the lateral columns. If the incidence of the pressure be such as to involve the bundles for the lower extremities early in the disease, these 'false signs' appear, and only careful neurological and other examinations will prevent the performance of laminectomy at a wrong level.

Dorsal Region.—When the growth is situated in the middle part of the dorsal portion of the cord, signs and symptoms may appear which are referable to segments above its level. Thus there may occur pain and paræsthesiæ along the internal aspect of the arm and in the fingers, which may precede or accompany true root pain. Vasomotor disturbances and a sensation of weakness may also be present in the same area. These 'false' localizing data have been variously explained as being the result of disturbances in the sympathetic system (p. 422), or as being due to irritation of the cord at this higher level consequent upon an increase in the pressure of the cerebrospinal fluid above the growth. Again, pain may be complained of in areas distal to the distribution of the segment of the cord involved. For example, a patient having a tumour in the mid-dorsal region may suffer from pain in the legs. Such pain is felt in a zone which does not usually correspond to the distribution of any one nerve, and may appear on the opposite side of the body after a unilateral course of months. It is increased by exercise and occasionally started by jerky movements of the spine. At the same time there may occur sudden momentary palsies of the legs as a result of which the patient may fall; similar momentary ataxias of the lower

extremity are also found.* Sometimes vasomotor disturbances of the lower limbs manifest themselves as a varying amount of oedema about the feet and ankles.

It is difficult to offer a satisfactory physiological explanation for these pains. The theory that they are due to pressure of the cerebrospinal fluid upon the posterior columns of the cord does not completely explain all the facts. This is certain, that their distribution places their origin in the cord itself and not in any of its nerve-roots. They are probably due to the pressure of the tumour upon the ascending tracts in the lateral columns of the cord, and like those occurring in cases of cervical growth offer evidence for the grouping of these fibres according to their ultimate connections. Their importance lies in the fact that if their true character is not recognized, the cord may be explored at a wrong level.

Conus and Cauda Equina.—Several distinctive features characterize the lowest part of the spinal canal and its contents:—

1. The lumbar and sacral portions of the bony canal are relatively roomy.
2. The spinal cord ends at the lower border of the first lumbar vertebra.
3. The lumbar, sacral, and coccygeal segments are very close together at the lower end of the cord. Thus they are crowded into that portion of it lying under the tenth, eleventh, and twelfth dorsal spines.
4. Below the level of the lower border of the first lumbar vertebra the bony canal is occupied by the lumbar, sacral, and coccygeal nerve-roots.

From these features two generalizations may be made with regard to tumours of this region:—

1. A relatively small tumour at the lower end of the cord may affect several cord segments, and therefore a wide peripheral area. Moreover, it may implicate several nerve-roots, as well as the cord itself.

2. A tumour of the cauda equina may grow to a very large size ('giant tumour') without definitely announcing its presence. The roominess of the canal and the mobility of the nerve-roots permit the growth to expand widely in all directions without causing symptoms of pressure upon the structures among which it is growing. Further, in this situation the clinical features will be referable to nerve-roots, and evidence of interruption of conducting tracts will be lacking. Rarely is it possible to foretell the level of such a tumour accurately, since widely separate areas are supplied by nerve-roots which here descend close to one another for considerable distances (p. 452). In comparison with other types of growth found in this situation the leptomeningiomas tend to give a relatively clear-cut picture (moderate size, encapsulation), although in many cases the history is a long one (slowness of growth).

The characteristic syndrome presented by a tumour of the cauda equina includes pain, atrophic paralysis of the legs, perianal and other anæsthesiæ, and disturbances of the sphincter muscles of the bladder and rectum.

* These findings are more common in cases where the cord is compressed by an extradural growth. They are probably due to sudden changes in the relation of the tumour to the cord.

Pain.—This is the first and may be for long the only symptom. It may be constant from the beginning or may become so only after one or more paroxysmal attacks. In character it is apt to be of the dragging, pulling, or burning type, and it is worst in the recumbent position. It is aggravated by jolting or twisting movements of the spine, and particularly by internal rotation and adduction of the hip-joint, a manoeuvre which stretches the affected roots. Oftentimes it begins as a diffuse vaguely localized ‘lumbago’, or over one or both trochanteric regions. Later it may radiate over the distribution of one of the main nerves of the limb, for example as ‘sciatica’, which may be bilateral. Occasionally there are paræsthesiæ such as numbness in the feet. Pain and tenderness over a particular vertebra may indicate the segment from which an affected root arises.

Atrophic Paralysis.—All degrees of atrophic paralysis up to complete palsy may be encountered. Usually by the time these patients come to operation muscles of both limbs are affected, although perhaps unequally. In the early stages fibrillary twitchings may be observed, and in some of these muscles atrophy may not be demonstrable, although definite loss of power and loss of tonus are present. Occasionally the paralysis are selective: thus bilateral footdrop is a common finding. When the growth is of sufficient vertical extent to reach the lower end of the cord itself, some of the muscles may be spastic while others are flaccid. The latter show the usual changes in their response to faradic and galvanic currents.

Anæsthesia.—In all the cases in this series sensory changes were present. The degree of loss varies from slight blunting of appreciation to total anæsthesia for all forms of sensation. If the changes are slight, the areas affected are ill-defined and difficult to delimit accurately; on the other hand, complete interruption of one nerve-root gives rise to an area which is sharply marked off from surrounding normal areas, since these may derive their supply from roots which take their origin some segments away from the affected root. Occasionally, as in the case of growths at a higher level, the loss of sensation may be dissociated; thus in one patient, where the tumour was at the lower border of the first lumbar vertebra, touch was felt over the whole of both limbs, although below the knees there was a loss of response to painful and thermal stimuli which was almost complete in the feet; and often the deep pressure sense alone is well preserved. A frequent finding is the so-called ‘saddle anæsthesia’, which involves the penis, scrotum, and perianal regions, and is due to involvement of the third, fourth, and fifth sacral roots. Occasionally the destructive process seems to pick out only a few fibres of a root, as in a case which presented a small oval area of total anæsthesia over Hunter’s canal on one side, in the territory of the third lumbar root. While in many cases the sensory changes are roughly proportionate to the degree of motor loss, the history of their appearance and progress does not aid the determination of the point of origin of the tumour, for the patient is often unaware that any sensory loss is present.

Reflexes.—As in other types of lower motor neurone palsy, the tendon-jerks are diminished or absent. When the growth presses upon the epiconus there may be evidence of interference with the pyramidal tracts, as in a case reported by Neuhof in which absent tendon-jerks were associated with bilateral

upward movement of the great toe on stimulating the sole of the foot. When the anal and bulbocavernosus reflexes are preserved the epiconus is obviously undamaged.

Disturbances of the Sphincters.—These are dealt with below.

XV. DISTURBANCES OF VESICAL, SEXUAL, AND RECTAL FUNCTIONS.

VESICAL FUNCTIONS.

Like other organs whose walls are composed of smooth muscle, the bladder receives nerves from both sympathetic and autonomic systems. All these nerves reach it from the hypogastric plexus. Those derived from the sympathetic system leave the spinal cord by way of the anterior roots of the third, fourth, and fifth lumbar nerves and pass to the inferior mesenteric ganglion, where the majority are interrupted and their impulses transferred to new neurones which pass without further interruption through the hypogastric plexus to the bladder wall. The autonomic fibres arise from the second and third sacral segments, and on each side unite to form the *pelvic nerve*. This passes to the hypogastric plexus, where the fibres have their cell stations; thence the new neurones pass to the bladder wall. There are numerous ganglia upon the ramifications of these nerves in the musculature of the viscus; their presence no doubt accounts for its capacity of contraction even after its connections with the central nervous system have been severed completely. The compressor urethræ or external sphincter is composed of striated muscle, and is innervated by the pudic nerve, derived from the second, third, and fourth sacral segments. The arrangement and distribution of these nerves is shown in *Fig. 273*, and what is known of

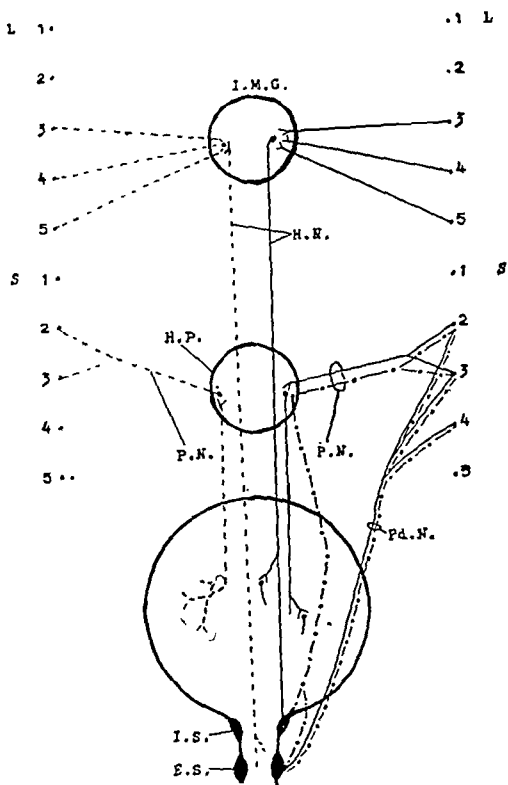


FIG. 273.—Diagrammatic representation of the innervation of the bladder and its sphincters, constructed from a paper by F. J. F. Barrington. (Cf. Table VIII.) L, Lumbar segments; S, Sacral segments; I.M.G., Inferior mesenteric ganglion; H.P., Hypogastric plexus; H.N., Hypogastric nerve; P.N., Pelvic nerve; Pd.N., Pudic nerve; I.S., Internal sphincter; E.S., External sphincter.

Efferent fibres : Motor ——— Inhibitory ———
Afferent fibres - - - - -

distribution of these nerves is shown in *Fig. 273*, and what is known of their functions may be tabulated as follows:—

Table VIII.—IMPULSES CARRIED BY NERVES OF THE BLADDER.

NERVE	EFFERENT		AFFERENT
	Excitor	Inhibitory	
Hypogastric . .	Bladder and urethra	—	Posterior urethra
Pelvic . .	Bladder	Both sphincters	Bladder
Pudic . .	Compressor urethrae	(Compressor urethrae)	—

According to Barrington, upon whose work the following description is based, reflex micturition depends upon five reflexes:—

“1. Distention of the bladder leads to a powerful sustained contraction of the bladder. Both afferent and efferent paths of this reflex are in the pelvic nerves. This reflex is abolished by dividing the spinal cord. . . .

“2. Running liquid through the urethra leads to a powerful sustained contraction of the bladder. The efferent path of this reflex is in the pelvic nerves, the afferent usually in the pudic nerves. This reflex is destroyed by transection of the spinal cord. . . .

“3. Distention of the posterior urethra leads to feeble, transitory contractions of the bladder. Both paths of the reflex are in the hypogastric nerves. The reflex is not destroyed by division of the spinal cord in the lower thoracic region.

“4. Running liquid through the urethra leads to relaxation of the urethra. Both paths of this reflex as it was observed were in the pudic nerves . . . the method of observation does not exclude the possibility of the other two pairs of nerves taking part in the efferent side of the reflex. The reflex is not destroyed by division of the cord in the lower thoracic region. . . .

“5. Contraction of the bladder provoked by distending it leads to relaxation of the urethra. The afferent path of this reflex is in the pelvic nerves, and the efferent in the pudic nerves. The reflex . . . is not abolished by dividing the cord in the posterior thoracic region.”

These observations were made upon various mammals, and it is uncertain how far the results can be applied to the act of micturition in man. Nevertheless, as will be shown, the various disturbances of control found in compression of the cord can be explained on the basis of Barrington's five reflexes.

The state of the sphincter muscles is under cortical control,* and this control is exercised according to information reaching the brain relative to the degree of distention of the bladder. Such impulses enter the spinal cord by way of the pelvic nerves, and are said to reach the higher centres through a series of short relays within its lateral columns. It is commonly found that sensory changes are already profound when the first derangement of the

* One cortical micturition centre, which controls the voluntary sphincter muscle and the bulbocavernosus muscle, is situated in the precentral gyrus, between the hip and shoulder motor centres. A second centre, controlling and inhibiting the internal bladder sphincter, is situated on the mesial aspect of each cerebral hemisphere, in the paracentral lobule, close the cortical centre for the toes. (Purves-Stewart.)

functions of the bladder appears, and this is attributed to the continued passage of sensations from the bladder along alternative short paths even after the main sensory tracts have been grossly affected.

The occurrence of vesical symptoms in the series under review will now be tabulated from two different standpoints: that of the level of the tumour, and that of the relation of the tumour to the circumference of the cord.

Table IX.—OCCURRENCE OF VESICAL SYMPTOMS AT VARIOUS LEVELS OF THE SPINAL CORD.

<i>Of 8 cervical tumours :—</i>					
Condition of bladder not stated .. .. .	..	..	..	..	1
<i>Of remaining 7 :—</i>					
No disturbance .. .. .	..	..	..	3 (43 per cent)	
Disturbance an initial symptom .. .. .	..	..	..	..	2
Disturbance a late symptom .. .. .	..	..	..	..	2
<i>Of 38 dorsal tumours :—</i>					
Condition of bladder not stated .. .. .	..	..	..	..	4
Urinary difficulty present, time of onset not stated .. .. .	..	..	..	..	1
<i>Of remaining 33 :—</i>					
No disturbance .. .. .	..	..	..	6 (18 per cent)	
Disturbance an initial symptom .. .. .	..	..	..	..	1
Average duration of all dorsal tumours .. .. .	..	..	..	..	32 months
Average interval before vesical symptoms appeared .. .. .	..	..	..	..	23 months
viz., after 72 per cent of the course of the disease had passed.					
<i>Of 10 lumbosacral tumours :—</i>					
Condition of bladder not stated .. .. .	..	..	..	..	0
Urinary difficulty present, time of onset not stated .. .. .	..	..	..	..	1
<i>Of remaining 9 :—</i>					
No disturbance .. .. .	..	..	..	2 (22 per cent)	
Disturbance an initial symptom .. .. .	..	..	..	..	1
Average duration of all lumbosacral tumours .. .. .	..	..	..	..	24 months
Average interval before vesical symptoms appeared .. .. .	..	..	..	..	19 months
viz., after 79 per cent of the course of the disease had passed.					
<i>Of 4 tumours of conus and cauda :—</i>					
Condition of bladder not stated .. .. .	..	..	..	..	0
Urinary difficulty present, time of onset not stated .. .. .	..	..	..	..	0
<i>Of these 4 :—</i>					
No disturbance .. .. .	..	..	..	..	0
Disturbance an initial symptom .. .. .	..	..	..	..	0
Average duration of tumours of conus and cauda .. .. .	..	..	..	..	49 months
Average interval before vesical symptoms appeared .. .. .	..	..	..	..	44 months
viz., after 90 per cent of the course of the disease had passed.					

Table X.—OCCURRENCE OF VESICAL SYMPTOMS IN THE VARIOUS RELATIONSHIPS OF THE GROWTH TO THE SPINAL CORD.

<i>Of 1 anterior tumour :—</i>					
Duration 66 months, disturbance an initial symptom					
<i>Of 11 anterolateral tumours :—</i>					
Condition of bladder not stated .. .. .	..	..	..	..	2
Urinary difficulty present, time of onset not stated .. .. .	..	..	..	..	1
<i>Of remaining 8 :—</i>					
No disturbance .. .. .	..	..	..	1 (12 per cent)	
Disturbance an initial symptom .. .. .	..	..	..	..	1
Average duration of all anterolateral tumours .. .. .	..	..	..	..	31 months
Average interval before vesical symptoms appeared .. .. .	..	..	..	..	27 months
viz., after 90 per cent of the course of the disease had passed.					
<i>Of 38 posterolateral tumours :—</i>					
Condition of bladder not stated .. .. .	..	..	..	..	2
Urinary difficulty present, time of onset not stated .. .. .	..	..	..	..	1

Of remaining 35 :—					
No disturbance	..	..	..	..	8 (23 per cent)
Disturbance an initial symptom	..	..	..	..	0
Average duration of all posterolateral tumours	..	..	..	..	31 months
Average interval before vesical symptoms appeared	..	..	..	..	18 months
viz., after 60 per cent of the course of the disease had passed.					
Of 7 posterior tumours :—					
Condition of bladder not stated	..	..	..	..	1
Urinary difficulty present, time of onset not stated	..	..	..	..	0
Of remaining 6 :—					
No disturbance	..	..	..	..	2 (33 per cent)
Disturbance an initial symptom	..	..	..	..	2
Average duration of all posterior tumours	..	..	..	..	12 months
Average interval before vesical symptoms appeared	..	..	..	..	11 months
viz., after 92 per cent of the course of the disease had passed.					

Consideration of these figures shows that there is little relation between either the level of the tumour or its position relative to the cord and the occurrence of vesical symptoms. An explanation of the latter may now be offered.

1. Lesions above the Level of the Second Lumbar Segment.—Urgency of micturition is the first complaint. In such cases all five reflexes are still operating, but some of the afferent impulses from the bladder to the brain have been interrupted. When the viscus reaches a certain stage of distention the whole sequence of reflexes is initiated. This does not result from a primary forcing of the sphincters, since contraction of the musculature of the bladder is evoked by a lower pressure than that necessary to do so; it is due to their reflex relaxation, unchecked by an ill-informed brain. When the urine has entered the posterior urethra the operation of the second and third reflexes makes the demand imperious.

As the fibres conveying bladder sensation become more involved, the ease with which this reflex escapes cerebral control increases. The patient passes through a stage of nocturnal incontinence (when the weakened cerebral control cannot be reinforced by conscious effort) to the stage of periodic reflex micturition of which he is aware, and finally to the stage of periodic reflex micturition of which he is totally unaware. It is to be noted that at no time is there a stage of retention with 'overflow incontinence' such as is present immediately after acute transverse lesions of the cord.

Periodic reflex micturition cannot be due to a return to the normal combination of bladder contraction and sphincter relaxation, for such patients have always a variable amount of residual urine in their bladders. Moreover, the first two reflexes described are no longer operative. But since the tonic influence of the pudic nerves upon the external sphincter is also absent, a certain degree of intravesical pressure will cause urine to enter the urethra; the remaining three reflexes then come into operation. The clinical features are therefore due to a relaxation of the sphincter mechanism. In addition the capacity of spontaneous contractility possessed by the musculature of the bladder may be sufficient to set in action the whole train of reflexes.

In the presence of a ventral tumour incontinence may occur only when the patient is recumbent: there is full control in the erect position. Probably the explanation of this feature is similar to that of the fact that root pain is worst at night (p. 430).

2. Lesions of the Second, Third, Fourth, and Fifth Lumbar Segments.—

The sequence of symptoms is the same as that detailed in the preceding paragraph, save that the relatively unimportant third reflex is not present to augment the urgency and force of the reflex act.

3. Lesions of the Second, Third, and Fourth Sacral Segments.—

In these lesions bladder symptoms appear relatively early, since the pressure is exerted upon both afferent and efferent fibres to the bladder where these are concentrated in the roots and cord. They are at first irritative, and since the pelvic nerves convey the majority of important stimuli to and from the bladder, there results a period of hypersensitivity of that organ, characterized by a frequent desire to micturate. The act may be painful if the bladder has to overcome the resistance of an external sphincter thrown into spasm as a result of pressure upon the nerve-roots supplying it. In the later stages there is incontinence, and this is of a different type from that previously described. Both the detrusor muscle and the main sphincter mechanism are paralysed, and the bladder becomes a sac devoid of sensation which is passively distended with urine. At intervals the intravesical pressure rises sufficiently high to force the internal sphincter, and urine escapes. The escape does not cease when the pressure falls below that level, for the third reflex is still intact, and the feeble contractions evoked through the hypogastric nerve may succeed in expelling an additional amount.

4. Lesions of the Cauda Equina.—In cases where the tumour implicates the cauda equina, disturbances of function of the bladder are by no means constant, and if present are a late feature. This is no doubt due to the escape of the whole or part of the fibres passing to the viscus. The clinical features are similar to those discussed in (3) above.

Cystoscopic Appearances.—The wall of the bladder is flabby, and trabeculation, if present, is slight. There is often marked loss of expulsive force. The condition of the sphincter varies with the level of the lesion, and may be deduced from the foregoing considerations. It is a noteworthy fact, and one which I have not seen emphasized elsewhere, that although somatic signs and symptoms may be referable almost wholly to interference with the conductivity of one-half of the cord, nevertheless the musculature of the bladder is affected as a whole. I have never observed unilateral atony in a case of cord bladder,

SEXUAL FUNCTIONS.

The act of erection is the result of efferent impulses which reach the penis through the pelvic nerves. It may be brought about in a reflex manner as a result of sensory impulses from the genitalia, which reach the cord by way of the pudic nerves; and it may also be accomplished through the action of cortical impulses upon the cells in the cord from which the efferent fibres of the pelvic nerves arise. Therefore lesions of the cord above the level of the second sacral segment diminish or abolish cortical control, and conscious erotic sensations (pudic nerves). Tumours situated at the point of origin of the pelvic nerves, and tumours implicating the second and third sacral roots, may diminish and even destroy the power of erection. Occasionally, as in a case in the present series which has been discussed by Parker, the power of

erection is retained while that of ejaculation is lost. This observer agrees with Spiller that such a finding is best explained by supposing that the fibres which govern the act of erection leave the cord at a higher level than those which control the ejaculatory muscles. The origin of the former is said to be chiefly in the second sacral segment. When the growth involves both segments, or the roots arising from them, neither erection nor ejaculation occurs.

RECTAL FUNCTIONS.

The rectum possesses two sphincters—an internal of plain and an external of striped muscle. The tonus of the former is maintained by the pelvic nerves; the latter is supplied by the pudic nerves. Of the two the external is by far the more efficacious, although when the motions are hard and formed the tone of the internal sphincter may be sufficient to retain them, even when the external sphincter is paralysed. When the tumour is above the level of the second sacral segment, the first disturbance of defæcation to appear is persistent obstinate constipation. Normally the entrance of fæces into the rectum gives rise to afferent impulses which produce the desire to defæcate. If the occasion be suitable, the tone of the external sphincter is relaxed by conscious cortical control. Extramedullary pressure gradually cuts off the external muscle from cerebral impulses; it remains tonically contracted, and constipation is the result. Later the tonic influences conveyed by the sub-cortical extrapyramidal tracts are gradually interrupted, and the external sphincter becomes more and more toneless. At first urgency and later incontinence occurs when the motions are fluid, as after the exhibition of purgatives. In the final stages even the slight tonus possessed by the internal sphincter may be lost—a condition for which there is at the present time no satisfactory explanation. In these circumstances, and provided the fæces are of a sufficiently fluid consistency, the rectum empties whenever fæces enter it. If the lesion is such that the muscles of the abdominal wall are paralysed, distressing flatulent distention of the bowel may appear, from the absence of their accessory aid in the act of defæcation. When the growth implicates the second, third, and fourth sacral segments, or the roots arising from these, the external sphincter may be paralysed at any stage, early or late, and incontinence results.

XVI. ACCESSORY AIDS TO DIAGNOSIS.

While a careful history and a complete neurological examination must always provide the greater part of the information upon which a diagnosis of extramedullary tumour is based, valuable confirmatory evidence may be obtained from two additional sources: (1) *An examination of the physical and chemical properties of the cerebrospinal fluid.* (2) *Radiography of the spinal column after air or lipiodol has been introduced into the subarachnoid space.*

1. EXAMINATION OF THE CEREBROSPINAL FLUID.

Properties of the Cerebrospinal Fluid in Health.—

PHYSICAL PROPERTIES.—If a hollow needle (the most suitable bore is 1.50 mm.) is introduced into the subarachnoid space and connected to a

three-way stopcock, the pressure of the cerebrospinal fluid may be measured by fitting to the vertical limb of the stopcock either a straight tube graduated in centimetres from its lower end—when the pressure is measured in terms of centimetres of cerebrospinal fluid—or a mercury manometer, when it is expressed in terms of millimetres of mercury. The former method is that usually employed (*Fig. 274*). When it is used, the range of pressure, taken with the subject lying on his side at rest and with head and spine in the same horizontal plane, is from 80 to 190 mm. Waves of increased pressure synchronous with the arterial pulse (3 to 5 mm.) and with expiration (5 to

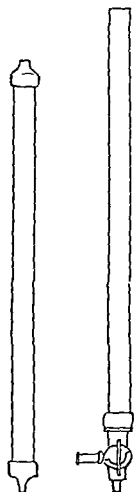


FIG. 274.—Cerebrospinal-fluid manometer, as made to the author's specification by Messrs. Down Bros. The stopcock is connected to a spinal puncture needle. By means of the tap, fluid may be taken for examination, or allowed to enter the manometer. The bore of the tube is 2 mm., and it is graduated in centimetres from the level of the needle. For high pressures the second piece is first fitted to the stopcock, and the piece at present in position is then joined to its upper end.

10 mm.) can thus be demonstrated, and for test purposes the pressures may be raised: (1) By the patient's coughing, crying, or sneezing. Forced expiration momentarily checks the return of blood to the heart, and so reduces the intracranial space available for the cerebrospinal fluid. (2) By obstructing the venous return from the head by digital compression of the internal jugular veins. The second of these methods is known as Queckenstedt's test.

Queckenstedt's Test.—Compression of the veins is best carried out by an assistant, while the operator observes the manometer. The rise and fall in subarachnoid pressure may be shown graphically, as in *Fig. 275*. The pressure may be lowered: (1) By the patient's taking a deep inspiration. As a result of expansion of the chest, blood is sucked from the cranial cavity into the heart. (2) By the withdrawal of fluid through the stopcock.

Normally there is free communication between all parts of the subarachnoid space, so that if manometers are connected to it both in the lumbar region and at the cisterna magna, provided that the cranial and caudal needles are in the same horizontal plane the pressures are identical, with the exception that the rise due to systole of the heart is more evident in the cranial manometer (on account of pulsation transmitted from the neighbouring large intracranial vessels). In health the fluid is clear, colourless, and sparkling. Its specific gravity is about 1.006, and it does not coagulate on standing.

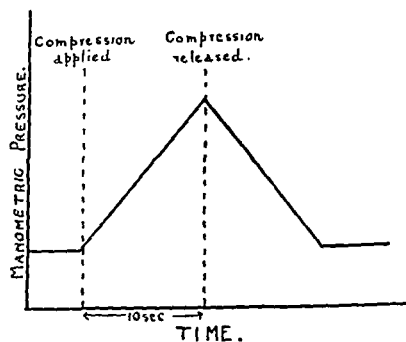


FIG. 275.—Graphical representation of type of response to Queckenstedt's test where there is no block. Both rise and fall are sharp, the former begins immediately pressure is applied, and neither occurs by stages. At the conclusion of the fall the pressure has regained its original level.

CHEMICAL PROPERTIES.—Only those properties variations from which are of use in the diagnosis of leptomeningiomas will be considered here.

Protein Content.—This varies from 5 to 15 mgrm. per 100 c.c. in fluid obtained from the ventricles to 30 to 40 mgrm. per 100 c.c. in fluid obtained from the lumbar sac. A figure higher than 50 mgrm. per 100 c.c. in fluid from the latter is definitely abnormal.

Fibrinogen and Thrombokinase.—These are absent.

CYTOLOGY.—In the sediment obtained after spinning healthy cerebrospinal fluid which is free from blood, but two types of cells are commonly seen under the microscope: (1) Small mononuclear lymphocytes form the greater number of cells; (2) Occasionally a large mononuclear cell is observed. This is either hæmatogenous in origin, or it is a shed arachnoid cell (p. 402). Normally the total number of cells present in 1 c.mm. of fluid does not exceed *seven to twelve*.

Changes in the Cerebrospinal Fluid in Cases of Leptomeningioma of the Cord.—

PHYSICAL CHANGES.—When spinal puncture is performed below the level of the tumour the cerebrospinal fluid is usually found to be under diminished pressure, although normal pressures are by no means uncommon, and occasionally increased pressures may be encountered. The usual explanation given for this diminution of pressure below a block is that this portion of the subarachnoid space is more or less completely cut off from the source of the fluid, so that there results a decrease in the quantity which it contains. Although hitherto it has been generally accepted, this theory does not entirely explain the loss of pressure, for it has been proved that sacs of the subarachnoid space isolated and emptied of their content fill again with fluid within twelve hours. It is probable, however, that this liquid is not true cerebrospinal fluid, but a transudate from the vessels of the cord which reaches the subarachnoid space from the perivascular lymph spaces. Thus there are sources of fluid other than the choroid plexuses, and since Elman has recently shown that but little absorption occurs around the issuing nerve-roots, the true explanation must be regarded as undetermined. Increased pressure below a block may be due to a valvular action of the growth. The circulation of the cerebrospinal fluid is constantly downward on the posterior aspect of the cord and upward on its anterior aspect. An extramedullary tumour may so fit its surroundings as to permit the downward while preventing the upward flow; exudation of serum from the distended spinal veins may also contribute to the increase.

The Demonstration of Spinal Block.—This is one of the most important confirmatory tests available in the diagnosis of tumour of the cord; it is of greater positive than negative value, and even when positive gives no clue to the level of the growth. It may be carried out in a variety of ways:—

1. By performing lumbar puncture in the usual manner. If there is a block in the space above the level of the interval between the third and fourth lumbar vertebræ, changes in the initial pressure of the fluid may be demonstrable with the manometer. Moreover, there may be an altered, lessened, or absent response to the methods of raising the general pressure in the space. Stookey has described five types of altered response, and these

are illustrated graphically in *Figs. 276 to 280*. The first three are conclusive evidence that a block is present, the last two inconclusive unless supported by clinical evidence of compression of the cord.

2. By the combined cistern and lumbar puncture of Ayer. In carrying out this test needles connected to manometers are introduced into the cisterna magna and the lumbar portion of the sac, the patient being prone on his side;

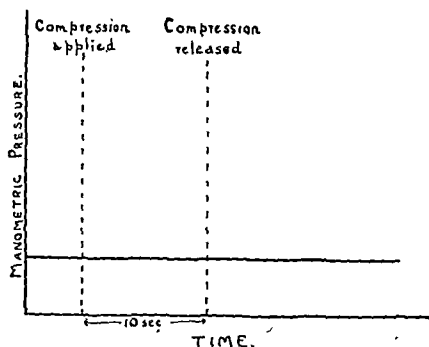


FIG. 276.—Absolute block. No response to jugular pressure.

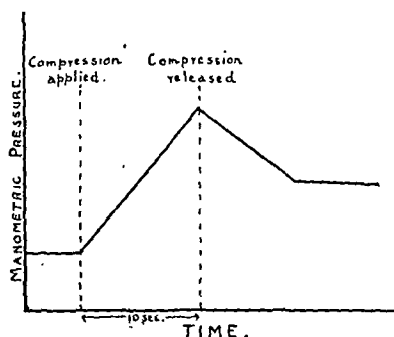


FIG. 277.—Sharp rise. Slow and slight fall. Pressure constant at new and higher level.

care is taken that the two needles are in the same horizontal plane. Pressure readings are noted as previously described, and a record is made of the response in each manometer to the heart's beat and expiration, to Queckenstedt's test, and to other means of raising the pressure of the fluid. About 5 c.c. of fluid are then withdrawn from the lumbar region; normally this causes a fall of 30.00 to 40.00 mm. in each manometer. In the presence of

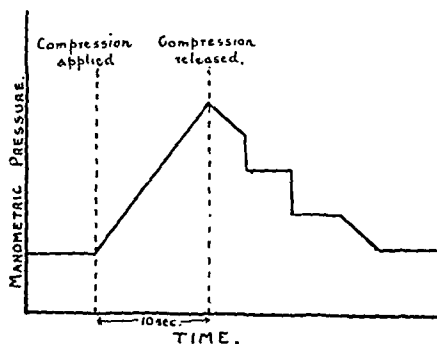


FIG. 278.—Sharp rise. Fall by stages to old level.

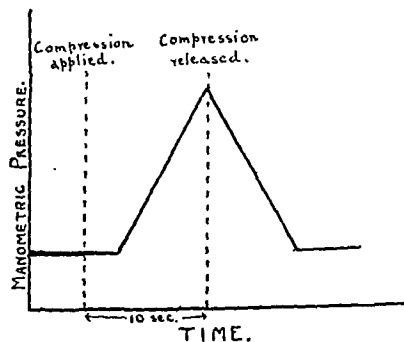


FIG. 279.—Delayed but sharp rise. Sharp fall to old level.

block the manometer connected to the cistern either does not show this decrease or it shows a smaller decrease, the appearance of which may be delayed. The observations on the cardiac and respiratory variations are then repeated; in cases of block they are but little affected in the cistern manometer, while in the lumbar manometer they may be even abolished. By a further application of this test the length of canal within which the block

must lie may be reduced. Thus the two needles may be approximated one to the other by performing punctures at lower and higher levels respectively. The cranial needle may puncture safely in turn the cervical intervertebral spaces down to that between the sixth and seventh vertebræ, while in the Mayo Clinic the caudal needle has been moved as high as the space between the seventh and eighth dorsal vertebræ. If both needles are shifted to the same side of the block in this way, the manometric readings become the same. If the reading in the cranial manometer becomes equal to that in the caudal, the level of obstruction must lie immediately above the last point of insertion of the former; while if the caudal manometer approximates to the cranial, the block must be immediately below the ultimate position of the caudal needle. (*Fig. 281.*)

3. When the tumour involves the cauda equina, lumbar puncture

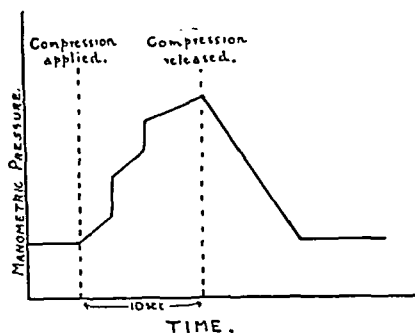


FIG. 280.—Rise by stages. Sharp fall to old level.

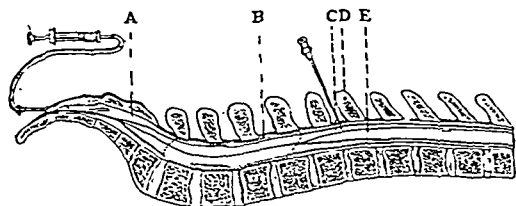
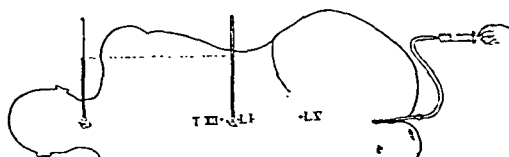


FIG. 281.—The upper figure represents the position of the two manometers in the double puncture of Ayer, and also the method of introducing fluid through the sacral hiatus. The lower figure shows how fluid in the epidural space affects a manometer connected to a spinal-puncture needle inserted between the twelfth dorsal and first lumbar vertebræ. A. Epidural space; B. Dotted outline of tumour; C. Subarachnoid space; D. Spine of twelfth dorsal vertebra; E. Spinal cord. (*From a paper by Cushing and Ayer.*)

frequently results in a 'dry tap'—that is, no fluid can be obtained (since the subarachnoid space is filled with tumour). Any block which exists below this level may be demonstrated in one of two ways:—

a. A test similar to that described in (2) may be performed, one needle being inserted between the twelfth dorsal and the first lumbar vertebræ, the other between the fourth and fifth lumbar vertebræ.

b. When the tumour lies below the latter level, the former needle alone is used. From 50·00 to 70·00 c.c. of normal saline solution are introduced into the epidural space through the sacral hiatus. Normally this will

cause a rise of pressure in the lumbar manometer, for the increase in the content of the bony canal is transmitted to the subarachnoid space through the dura. If the sacral canal contains a tumour, the increase, if present at all, is but slight, and it may be impossible to inject the full quantity of fluid.

(To introduce fluid into the epidural space, the apex and diverging sides of the sacral hiatus must first be identified. The needle is inserted into the sacral hiatus in a perpendicular direction until it is felt to have pierced the ligamentous roof of the opening. It is then brought into the plane of the sacral canal, and pushed onward for five to six centimetres. Before beginning the injection the piston of the syringe should be withdrawn, to ensure that the point of the needle is not resting in a vein.)

CHEMICAL CHANGES.—Chemical changes in that portion of the cerebrospinal fluid below a tumour seem to owe their existence to two factors: the block in the circulation of the fluid, and the compression of the cord. It must be understood, however, that compression of the cord and stasis of the fluid may be present without demonstrable chemical abnormality in the fluid below the block, so that chemical tests have a greater positive than negative value.

The first alteration which may be observed is an increase in the protein content of the fluid. This may be demonstrated by one of the following tests, after care has been taken that the fluid is not contaminated with blood.

1. *The Nonne or Nonne-Apelt Test.*—To 1.00 c.c. of cerebrospinal fluid in a small test-tube add 1.00 c.c. of a saturated solution of ammonium sulphate, mix, and allow to stand for three minutes. At the end of that time compare with a similar control tube containing cerebrospinal fluid alone. A positive reaction is indicated by turbidity or even precipitation in the first tube.

2. *The Pandy Test.*—This, the better of the two tests, is performed as follows. Place 1.00 c.c. of a saturated solution of carbolic acid in distilled water in a small test-tube, and add one drop of cerebrospinal fluid. A positive reaction is indicated by the formation of a faint white cloud where the increase is small, or actual precipitation where a large amount of protein is present. The presence of increased protein in the cerebrospinal fluid, with no increase in the cell-count—the Nonne syndrome—is strong evidence of the presence of a spinal-cord tumour, especially if block can also be demonstrated.

Cerebrospinal fluid obtained from the subarachnoid space below a block may show a *yellowish tinge*. The pigment is of hæmatogenous origin, and is present either as the result of transudation from the engorged veins, or from the breaking down of small areas of hæmorrhage which have occurred in vascular tumours, the hæmoglobin being transformed into bilirubin. The second source is rarely contributory in cases of block caused by the type of tumour under discussion. In 1903 Froin described a condition of the cerebrospinal fluid occasionally found below a block, which includes *increased protein content, presence of a yellowish colour, and capacity of spontaneous coagulation*—‘*xanthochromie et de coagulation massive*’—combined with a *normal or but slightly increased cell-count*. The association of these features is characteristic of the isolation of part of the subarachnoid space by a non-inflammatory process. Leschke states the incidence of coagulation in cases of extramedullary tumour as 24 per cent; in cases of tumours of the cauda equina as high as 90 per cent. It is not mentioned in any of the case reports in this series. The complete Froin syndrome occurs in from 20 to 30 per cent of all cases showing a yellow cerebrospinal fluid. Spontaneous coagulation is due

to the presence of large amounts of albumin, fibrinogen, and fibrin ferment. The amount of the first substance may be as much as 2.01 grm. per 100 c.c. (normal about 0.02 grm.). The coagulation may occur almost immediately on withdrawal of the fluid, or not until after a period of some hours.

Recently Cushing and Ayer have drawn attention to the fact that increased protein content without xanthochromia (two cases) and even the complete Froin syndrome (one case) may be present in the cerebrospinal fluid above a tumour. Hanmes has noted the latter condition in a case under his observation. The source of the protein and fibrinogen in these cases is more obscure; an inflammatory process is excluded by the absence of increased cell-count. Cushing and Ayer suggest the possibility of transudation from engorged veins below a partial block, and even from the surface of the tumour itself. Mixer has described an unusually high protein content in fluid from the lumbar sac above tumours of the cauda equina.

Finally, as pointed out by Stewart and Riddoch, fluid in an isolated sac of the spinal subarachnoid space is separated from the source of any ferments passed into the space from the choroid plexus and pituitary body.

After this discussion upon the changes in the cerebrospinal fluid, data from the case reports which form the basis of this paper may be presented in tabular form. Of a total of 60 cases, the spinal fluid was partially or completely examined in 40.

Table XI.—SUMMARY OF CONDITION OF CEREbroSPINAL FLUID IN 40 CASES.

<i>Pressure</i> :—Not stated	..	..	..	..	22
Normal	..	..	..	..	3
Reduced	..	..	..	..	3
Absent	..	..	..	..	1
Increased	..	..	..	..	2
Measured	..	..	..	..	9
					{ Hg 6, 8, 15 mm. C.S.F. 4, 6, 7, 10, 11, 12 cm.
<i>Block</i> :—Not stated	..	..	..	..	30
Absent	..	..	..	..	2
Present	..	..	..	..	5
Partial	..	..	..	..	3
<i>Colour</i> :—Not stated	..	..	..	..	23
Normal	..	..	..	..	7
Yellow	..	..	..	..	8
Gold	..	..	..	..	1
Amber	..	..	..	..	1
<i>Pandy or Nonne Test</i> :—Not stated	..	..	..	..	7
Positive	..	..	..	..	22 (66.7 per cent)
Negative	..	..	..	..	11 (33.3 per cent)
<i>Number of cells per c.mm.</i> :—Not stated	..	..	..	..	3
No pleocytosis					}
Less than 12					
More than 12	..	..	..	..	2
R.B.C.*	..	..	..	..	1
<i>Coagulation</i> :—Never noted					
<i>Wassermann or Kolmer</i> :—Not stated	..	..	..	..	2
Negative	..	..	..	..	38
<i>Colloidal Benzoin Test</i> :—Not helpful, but on the whole flocculation most marked in tubes 8-11.					

* Probably due to contamination with blood.

2. RADIOGRAPHY.

Pneumography.—The method of localizing cerebral tumours by the introduction of air into a lateral ventricle, and subsequent radiography of the head in various positions (as elaborated by Dandy) has been adapted to tumours of the spinal cord. Quantities of air varying from 5·00 to 50·00 c.c. are injected into the subarachnoid space through a lumbar puncture needle after an equivalent quantity of cerebrospinal fluid has been allowed to escape. Radiograms are taken after an hour or two, with the patient in the erect position, in the hope that the bubble of air will be arrested at the level of the tumour where it will be visible in the photographs. The assistance derived from this procedure may be classified under two headings:—

1. *The Upper Limit of the Air-bubble.*—As an aid to the diagnosis of the level of the neoplasm this has proved disappointing; the upper border of the column of air is often so indistinct as to be of slight value in localization.

2. *The Level of the Pain which Appears after such Injections.*—This is of much more diagnostic value, but decidedly unpleasant for the patient. After a few hours, pain appears at the level of the tumour, and radiates round the body along the nerves arising from the segment involved. This pain is said to be due to the passage of the air past the growth. After it disappears, and in cases where there is no tumour, severe headache may follow. This is doubtless the result of entrance of the air into the ventricles of the brain.

The Use of Lipiodol.—The principle underlying the use of lipiodol is that of the introduction into the subarachnoid space of a substance opaque to the X rays. This substance sinks rapidly when the patient assumes an erect position, is arrested at the level of the tumour, and may be demonstrated there in radiograms. Lipiodol is a colloidal solution of iodine in oil of poppy, in the proportion of 0·54 cgrm. of iodine to 1 c.c. of the oil. It is stated by its inventors to be non-toxic and non-irritating.

The technique of its introduction has been described by Sicard, Paraf, and Laplane, who first elaborated and used it. The oil is usually injected by puncture of the atlanto-occipital ligament. This structure lies some 3 to 5 cm. from the skin; the dura at the site of puncture is $1\frac{1}{2}$ cm. distant from the medulla oblongata. No cerebrospinal fluid should have been removed from the patient for at least six or eight hours before the injection. This may be made with the patient in the sitting position (Sargent) or lying on his side with head and shoulders slightly raised (Sicard). In either position the head must be well flexed to open up the space between the atlas and the occipital bone. After surgical preparation of the skin a point is selected where a line joining the tips of the mastoid processes crosses the mid-line, and the skin in this area is anæsthetized with a 2 per cent solution of novocain. A spinal-puncture needle is then fitted to a Luer syringe containing about 2·00 c.c. of normal saline solution. The needle is entered immediately to one side of the point described (to avoid the ligamentum nuchæ) and pushed steadily forward and a little upward until it reaches the occipital bone, when the point is depressed, and the needle passed through the atlanto-occipital ligament and dura. If the saline is slowly injected as the needle is introduced, the lumen of the latter is kept patent, and when its point reaches

the subarachnoid space the sudden decrease in resistance to injection as well as the sensation of piercing the membranes indicate to the operator that the puncture has been accomplished. Moreover, the outflow of fluid tends to remove the medulla from any possible injury by the entering needle point. The safety of the procedure has been questioned owing to the proximity of the circular vein round the foramen magnum, but apparently this has never been wounded. When the syringe is disconnected the cerebrospinal fluid either escapes very slowly in drops, or may require to be withdrawn with the syringe; but after verifying the puncture in this way only a few drops should be allowed to escape before completing the injection.

Before the lipiodol is introduced attention must be paid to several technical points: (1) The oil must be transparent; certain specimens tend to lose this essential property. (2) It may be warmed to the temperature of the body by immersing the ampoule in water at 100° F. This decreases its viscosity and thus facilitates its injection. (3) When taken up into the syringe the oil must be quite free from air-bubbles; these tend to make it cling to the meninges. From 1.00 to 1.50 c.c. of lipiodol is then injected slowly, the final traces of the substance being washed from the needle by one or two cubic centimetres of warm saline solution from a second syringe. The needle is withdrawn at once. The whole procedure should be quite painless.

The oil may also be introduced between the fourth and fifth or fifth and sixth cervical vertebrae; or if it is desired to outline the lower border of the tumour, by ordinary lumbar puncture. The technique is essentially the same save that the needle should be allowed to remain in position for one minute before removal to prevent leakage of cerebrospinal fluid and lipiodol into the epidural space.

After the injection into the cistern the patient should be made to sit up, if he is not already in this position, and the upper cervical spines should be percussed firmly to aid the fall of the oil. He should be forbidden to assume the horizontal position for three to four hours. When no block is present the lipiodol reaches the dural cul-de-sac at the level of the second sacral vertebra in five or six minutes. From one to four hours after the injection X-ray pictures of the spine are taken. Exposures should be made with the patient erect, and in the dorsal decubitus with head and shoulders raised. If the oil has been checked in its descent, these exposures are repeated after two or three days, to define any later changes in its level. It is inadvisable to take lateral views with the patient prone on his side, as the normal curve of the lower spine allows the oil to flow back to the region of the fifth lumbar vertebra.

The radiological appearances in cases where a tumour is present vary: (1) In cases where the block is complete the lower edge of the column of lipiodol may be straight. (2) It may conform to the outline of the upper border of the tumour. (3) Some of the lipiodol may outline the tumour while the remainder falls to the sacral cul-de-sac. (4) Sometimes minute shadows of lipiodol may be seen irregularly scattered throughout the length of the subarachnoid space above the block or cul-de-sac. These correspond to the positions of calcareous plaques on the arachnoid membrane. (When the oil is introduced by lumbar puncture the radiograms are, of course, taken with

the head of the patient lowered, since it is the lower border of the growth which is being outlined.)

The inventors state that they have never seen headache, vomiting, or general malaise follow the use of lipiodol. Some hours after the injection there may be shooting pains or uneasiness in the legs, but these are transient. Apparently the iodized oil is well tolerated. It is demonstrable in the sacral cul-de-sac two years after its introduction, and very little absorption takes place in that time.

XVII. DETERMINATION OF THE LEVEL OF THE TUMOUR.

THE RELATION OF CORD SEGMENTS TO BONY LANDMARKS.

The spinal cord ends at the level of the lower border of the first lumbar vertebra, and is therefore considerably shorter than the spinal canal; thus a segment of the cord is not situated opposite its corresponding bony segment. The nerve-roots have a general downward direction toward the intervertebral foramina, and the length of their courses within the spinal canal increases from above downward, as is well shown in *Table XII* (after Soulie).

Table XII.—INTRADURAL LENGTH OF THE ROOTS OF THE SPINAL NERVES:
AVERAGE LENGTH IN MILLIMETRES.

CERVICAL		THORACIC		LUMBAR		SACRAL		COCCYGEAL
No.	Mm.	No.	Mm.	No.	Mm.	No.	Mm.	Mm.
1	3	1	29	1	91	1	185	266
2	8	2	35	2	110	2	196	
3	16	3	38	3	132	3	221	
4	18	4	43	4	151	4	239	
5	20	5	45	5	170	5	262	
6	23	6	47					
7	25	7	49					
8	27	8	49					
		9	52					
		10	55					
		11	58					
		12	81					

A given segment of the cord is thus always situated more cranially than the corresponding vertebra. Various rules have been evolved by means of which the spinal canal may be opened at the proper level to expose a given segment. While there are individual variations of relation, which have been studied by Reid, the rule given by the Committee of the Medical Research Council on Injuries of the Nervous System may be quoted in full:—

"1. The intraspinal course increases fairly regularly for the cervical and thoracic nerves. It is about equal to the depth of one vertebra for the upper cervical and of two vertebræ for the lower cervical; of three vertebræ for the upper thoracic and of four vertebræ for the lower thoracic.

"2. The origins of the lumbar nerves (segments) are opposite the tenth and eleventh thoracic spines.

"3. The origins of the sacral nerves (segments) are opposite the twelfth

thoracic spine and the interspinous ligament between it and the first lumbar spine.

"In applying these rules it must be remembered that the spinous processes vary much in length and obliquity, so that in the mid-thoracic region the tip of one spine may reach the level of the middle of the body of the next vertebra but one below it. Moreover, the nominal relation of nerves to vertebrae changes at the eighth cervical nerve—above this level the nerve issues above the vertebra of the same name; below this level the nerve issues below the vertebra of the same name."

The task of the clinician is to determine as accurately as possible the segment of the cord involved. The surgeon then plans a laminectomy suitable for the exposure of this segment. In arriving at the level of the growth information is derived from an analysis of the data given below.

DATA FROM WHICH THE LEVEL OF THE GROWTH IS DETERMINED.

The level of the growth may be determined from the following data:—

1. *Sensory Features*: (a) Referable to roots: (i) Somatic; (ii) Splanchnic.
(b) Referable to conducting paths: (i) Somatic; (ii) Splanchnic.
2. *Motor Paralysis*: (a) Upper neurone type; (b) Lower neurone type.
3. *The State of the Reflexes*: (a) Somatic; (b) Splanchnic.

1. *Sensory Features*.—

a. SENSORY FEATURES REFERABLE TO ROOTS.—

i. *Somatic*.—

a. *Pain*.—The site of the original pain, provided this has been constant, and its subsequent radiation, are valuable aids in estimating the level of the growth. According to Bruns, root pain should be referred to the corresponding segment of the cord and not to pressure upon the root as it descends in the spinal canal. It appears to me, however, that cases in which a process of the tumour occupies an intervertebral foramen will form an exception to this rule. When tenderness of one spine is a marked and early feature, it may indicate the posterior root upon which the growth is pressing.

β. *Sensation*.—It has been seen that the destruction of one root does not give rise to sufficient anaesthesia to be of localizing value. When two roots are interrupted the loss is more appreciable, and if three roots suffer, a definite zone of complete loss will be present, and this indicates the level of greatest pressure. For purposes of localization, a study of the area of 'over-reaction' above the tumour level is most helpful. If sensation is tested carefully from above downward, and the level at which *abnormal* sensibility makes its appearance noted, this will represent the level of the upper limit of the lesion of the cord. The limits of anaesthetic areas are best determined where these abut upon areas which derive their nerve-supply from a distant segment of the cord. Thus about the second thoracic interspace the territory of the third and fourth cervical segments meets that of the second dorsal segment, and over the buttock the territory of the first lumbar segment meets that of the third sacral segment.

ii. *Splanchnic*.—Occasionally loss of visceral sensation is an aid to localization, and careful inquiry should be made as to this point. Even in severe

degrees of somatic sensory and motor loss, some visceral sensibility may be retained; this is probably due to the nature of the pathway by which such sensations rise to consciousness (*see* p. 439). In the case of lesions below the ninth and tenth dorsal segments distention of the stomach can always be appreciated. With regard to the bladder, it is important to find out if the patient recognizes the desire to micturate, and if he is conscious of the act. Sometimes the passage of a catheter is felt only when the instrument reaches the trigone of the bladder; and this in spite of extreme pressure upon the lumbar cord. Care must be taken that the patient does not mistake the sensations evoked by the pressure of a distended bladder upon other abdominal viscera for real appreciation of the fullness of the organ. The presence or absence of rectal sensation, and consciousness of the act of defæcation, should also be investigated. In one case in this series the patient was confined during the course of the disease; the pains were slight.

b. SENSORY FEATURES REFERABLE TO CONDUCTING PATHS.—

i. Somatic.—The sharpness with which the level of the anæsthesia can be mapped out varies with the size and consistence of the tumour, and with the roominess of the bony canal. A small hard growth which indents the cord deeply leads to the most complete interruption. In determining sensory levels the examination must include tests of all forms of sensation, for, as has been mentioned, dissociated anæsthesia is sometimes present. It must be remembered that in estimating the degree of loss of tactile and thermal sensation, these must be considered as a whole; on account of the regrouping of fibres which takes place in the cord the ability to distinguish between 'protopathic' and 'epicritic' sensibility is abolished. The preliminary determination should be made for pain, since touch loss is often slight and very indefinite in less extensive lesions. Care must be taken that the patient understands that it is sensibility to actual pain which is being investigated, for a needle prick may be appreciated as touch though loss of sensibility to pain is absolute.

When some idea of the level of sensory loss has been reached, the levels for touch, pain, and temperature should each be determined as accurately as possible. As has been pointed out, the level will often be most definite when the insensitive area marches with an area supplied by a distant segment of the cord. In some cases it will be impossible to determine the exact level at which normal sensibility is replaced by abnormal, but the attempt should be made in all by working carefully from normal to definitely abnormal skin; in this way some information may be gained as to the upper limit of the lesion, and this part of the examination assumes its greatest importance when root symptoms have been slight or absent. When the case is not seen until the late stages, and a complete or almost complete interruption of the cord is present, the level of total anæsthesia may be very definite indeed; but it must be emphasized that this level is a guide only to the lowest segment which is completely interrupted, and gives no indication of the vertical extent of the lesion. When the vibratory sense is being tested, mistakes may arise from the vibrations of the fork being transmitted along the bones of the leg from an insensitive to a sensitive area. The tuning-fork test is more reliable when applied to the abdominal wall; and it often proves of value when applied to the spinous processes of the vertebræ, when it may be found that

there is a marked difference of appréciation between two adjacent vertebrae. (The vertebra at which vibratory sensation is regained indicates the lowest segment of the cord in which some conductivity is retained, and not, of course, that the tumour lies beneath it.) The most definite levels of loss of vibratory sense are obtained when the growth is dorsal or dorsolateral and presses upon the posterior columns of the cord.

When the extent of sensory loss has been determined as accurately as possible, it must first be reduced to terms of *segmental level of the cord*, and finally to terms of *actual level of compressing growth*: and both are best estimated from the level of the loss for sensations of pain. The final localization depends upon a suitable allowance for the obliquity with which the neurones of the second series cross the cord, and the level of compression is estimated at the number of segments cephalward which is suitable for the particular part of the cord involved (*see p. 421*).

ii. *Splanchnic*.—These features have been included in the section on symptoms referable to roots.

2. Motor Paralyses.—

a. *Upper Neurone Type*.—The level of the growth may be roughly estimated by determining the extent of the spastic paralysis present. When the most proximal paralysed muscles have been identified, the segment of cord from which they are innervated is taken as the highest showing evidence of pressure upon the pyramidal tract.

b. *Lower Neurone Type*.—The situation of flaccid muscular paralysis is almost diagnostic of the site of pressure upon the cord, since in the vast majority of cases it is the result of pressure upon anterior nerve-roots. Foix, however, comments upon a case where the tumour pressed upon the second, third, and fourth cervical segments, which was complicated by atrophy of the small muscles of the hand (eighth cervical). This finding he attributes to anterior radiculitis, possibly due to compression of the roots in question by the cerebrospinal fluid below the tumour. As has been pointed out, each muscle is supplied by three adjacent segments, so that for its complete paralysis a growth of sufficient vertical extent must be present.

3. The State of the Reflexes.—

a. *Somatic Reflexes*.—The hyperactivity of tendon-reflexes which is present in spastic paralysis may be utilized in arriving at the level of the growth. Many cord segments are definitely associated with a certain reflex, and if this is found to be increased the pyramidal tract must be compressed above that level. Before deciding that a reflex is increased those which are presumably unaffected should also be examined; thus a normal standard may be established for the individual. The highest point of compression of the pyramidal tract will then be indicated by the level of the segment which supplies the muscle first showing an increased tendon reflex. The method of arriving at this level is shown in *Fig. 282*. Entire absence of a given reflex, while reflexes proximal and distal to it are maintained, is even more valuable for purposes of localization, since it indicates a destructive lesion at the level of the cord subserving the reflex, provided, of course, that the paraplegia has not advanced to the flaccid stage. Thus the lower abdominal skin-reflexes may be absent although the epigastric skin-reflex and the cremasteric reflex are present.

When the lower limbs are spastic in flexion, stimulation of any part of the skin up to that supplied by the lowest part of the cord compressed may give rise to a sequence of events known as the *reflex of defence*. This reflex

has been the subject of much controversy and speculation. Briefly it may be stated that it is a combination of flexion at the hip and knee, and dorsiflexion of the toes—especially the great toe; if the bladder is full, it may be emptied; profuse sweating of the anæsthetic skin may occur; and there are often extension movements of the contralateral leg if this has been flexed before the reflex is elicited (probably a return to primitive correlated movements.) The reflex is most constantly and completely obtained when the skin of the sole of the foot is the area stimulated, and its intensity is diminished the farther from this point the stimulus is applied. The latter may be tactile, painful, or thermal, and stimulation of the deeper tissues by tarsal compression or blunt pressure is also effectual. As a general rule in cases of leptomeningioma the level up to which this reflex can be evoked coincides fairly closely with the level of anæsthesia; a broad band separating the two levels is more suggestive of the presence of a diffuse pathological process such as chronic meningitis. If knee- or ankle-clonus is obtainable in the limb, it may be inhibited by pinching any part of the skin up to the level which is supplied by the lowest segment

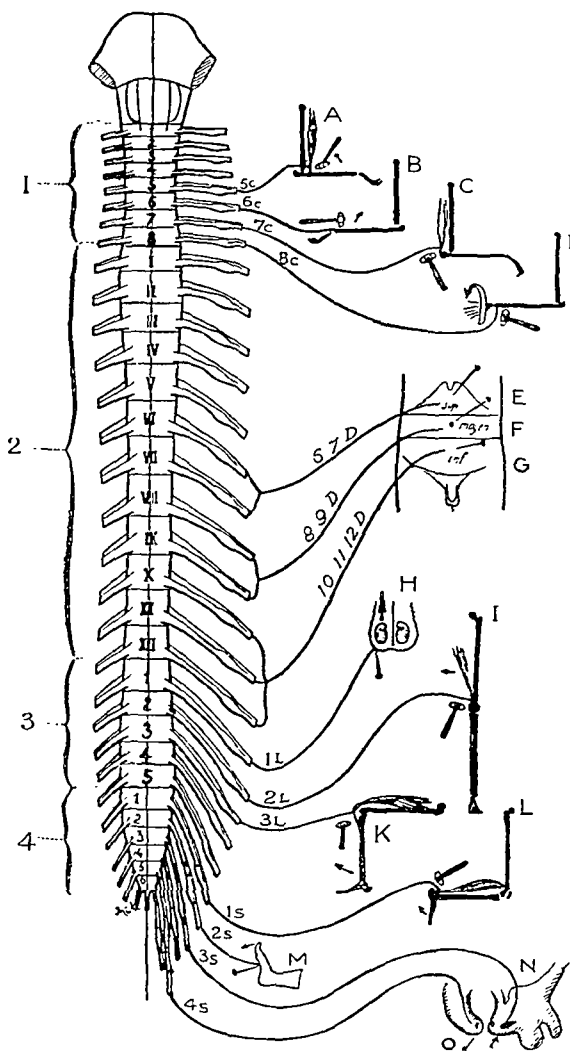


FIG. 282.—Scheme of the principal spinal reflexes, to illustrate method of determining approximate level of lesion. 1, Cervical cord; 2, Dorsal cord; 3, Lumbar cord; 4, Sacral cord. Reflexes: A, Biceps; B, Supinator; C, Elbow-jerk; D, Pronator; E, F, G, Upper, middle, and lower abdominal; H, Cremasteric; I, Adductor-jerk; K, Knee-jerk; L, Ankle-jerk; M, Plantar; N, Bulbocavernosus; O, Anal.

of the cord which is compressed, and determination of this level thus gives additional information as to the lower limit of the lesion.

b. Sympathetic Reflexes.—Our knowledge of the value of these reflexes is largely derived from the work of French neurologists, and particularly of

Thomas. This observer determined the distribution of sympathetic fibres already detailed (p. 423) by using the pilomotor reflex, which is evidenced by bristling of the hairs on stimulating the skin either of the nape of the neck or of the anæsthetic area. As a guide to the level of a growth its distribution must be accepted with caution. The sudomotor reflex, obtained in the same way, is most variable and inconstant, and may result either in hyperidrosis or anidrosis. Occasionally a vasomotor reflex can be elicited by stimulating the skin of the anæsthetic area; the vasodilatation extends to the level supplied by the sympathetic fibres passing from the segment below the interruption; this may or may not coincide with the somatic sensory loss.

XVIII. DIFFERENTIAL DIAGNOSIS.

This condition must be diagnosed from: (1) *Other forms of intradural extramedullary tumour*; (2) *Extradural tumours*; (3) *Chronic myelitis and meningomyelitis*; (4) *Syringomyelia*; (5) *Osteo-arthritis*; (6) *Other miscellaneous lesions*.

1. Other Forms of Intradural Extramedullary Tumour.—

Simple Tumours.—Inflammatory growths of *tuberculous* or *luecic* origin are not uncommon in the spine. A complete examination of the cerebro-spinal fluid shows pleocytosis as well as increased protein content, and possibly a positive Wassermann reaction. There may be evidence of tuberculosis or syphilis elsewhere in the body, and the X rays may reveal associated lesions in the neighbouring vertebræ. It is wellnigh impossible to exclude other growths such as *neurofibroma*, *fibroma*, *myxoma*, and the relatively non-malignant form of glioma known as *ependymal cell glioma*. Root pains are rarely absent and usually severe in cases of neurofibroma. Softer tumours (myxoma, glioma) more frequently give rise to xanthochromia. Moreover, some gliomas and certain degenerating neurofibromas erode the bony casing of the cord, an effect which may be demonstrated radiographically. Of all simple tumours the leptomeningiomas are of the hardest consistency; thus, broadly speaking, they lend themselves to the most definite localization.

Malignant Tumours.—Of these, *sarcoma* and *glioma* are the commonest. The history is relatively shorter (occasionally as brief as seven to ten days) and the progress of the disease more acute; for such tumours grow rapidly, and moreover hæmorrhages from ill-supported vessels may at any time intensify existing features, or lead to a sudden change in the clinical picture (sudden paraplegia). The spinal fluid is apt to be yellow.

2. Extradural Tumours.—

Simple Tumours.—A *chondroma* may be identified in radiograms. *Neurofibromas*, and *lipomas* springing from the extradural fat, give rise to no characteristic symptoms, although the former may be associated with similar growths elsewhere in the body. Rigidity of the spine over the growth is a common feature.

Malignant Tumours.—When arising in the bony column such growths may show destruction of bone in X-ray plates of the spine. *Secondary malignant growths* in the vertebræ may be traceable to a primary focus; occasionally they may be felt from or may even reach the surface. They are apt to give

rise to symptoms of sudden transverse interruption of the cord, not from the pressure they exert but because they cause thrombosis in the vessels of the cord. A type of diffuse *sarcoma* of the dura occurs, which from its considerable vertical extent causes symptoms referable to many segments of the cord. *Multiple myelomas* may be identified in other bones, and the blood picture and urinary findings (Bence-Jones albumosuria) are helpful.

3. Chronic Myelitis and Meningomyelitis.—A focus of infection may be found, for example in the prostate. In the first condition, most common in the dorsal region, there is no spinal block, and pain if present is never so severe as in cases of tumour, nor is it of the root type. Chronic meningo-myelitis is sometimes difficult to exclude. As a rule the clinical features in this disease suggest the presence of a lesion of considerable vertical extent, and the symptoms and signs conform to the varying anatomical relations of the lesion to the cord and nerve-roots. While block may be present, in this condition, as in myelitis, pleocytosis is present in the cerebrospinal fluid.

4. Syringomyelia.—In this disease the anaesthesia is of the dissociated type, and the characteristic early motor lesion is flaccid palsy of the small muscles of the hand. Such manifestations as painless whitlow, arthropathies, etc., may help to exclude cord tumour. There is no spinal block.

5. Osteo-arthritis.—This condition, especially frequent in the lumbar spine, may simulate cord tumour very closely. Root pains occur, and the bony outgrowths may lead to partial spinal block. Suggestive points are arthritic lesions elsewhere and the presence of foci of infection which might account for the condition. The X rays reveal the structural alterations in the spine.

6. Other Miscellaneous Lesions.—*Echinococcus cysts* not uncommonly form in the spinal canal, in countries where this disease is prevalent. Cysts may have been removed from other parts of the body, and the serum of the patient may show complement fixation with an echinococcus antigen.

In the region of the cauda equina *toxic neuritis* of the nerve-roots may closely mimic tumour growth. A cause for the neuritis may be found, but more frequently the diagnosis is made only after exploratory laminectomy. A dry tap is less frequently made in these cases. *Pelvic tumours* involving the nerves of the lumbosacral plexus are excluded by rectal examination. *Haematomyelia* and *haemorrhachis* have an acute onset, oftenest after trauma. In the presence of extensive cardiovascular disease, sudden development of a transverse lesion suggests the diagnosis of *thrombosis of a spinal vessel*.

XIX. OPERATIVE TREATMENT.

The technique of laminectomy is now so well standardized that it is not proposed to describe the preliminary stages of the operation. Suffice it to say that in my opinion no 'flap' or osteoplastic method of exposing the theca is superior to the ordinary procedure. The operation may be performed under local anaesthesia, either by infiltration or by blocking the nerve-roots as they emerge from the intervertebral foramina (paravertebral anaesthesia), or a general anaesthetic may be administered. If the latter is chosen, probably ether given by an intrapharyngeal tube is best. Even when a general

anæsthetic is used it is advantageous to infiltrate the operative site with a weak solution of novocain ($\frac{1}{2}$ per cent) to which a solution of adrenalin hydrochloride (1-1000) is added in the proportion of 10 drops of adrenalin to 100 c.c. of novocain solution. Such a procedure reduces bleeding and minimizes shock arising from operative trauma.

Surgical interference with the cord demands from the operator even greater gentleness than is necessary in dealing with the brain. The nerve-roots and the cord itself

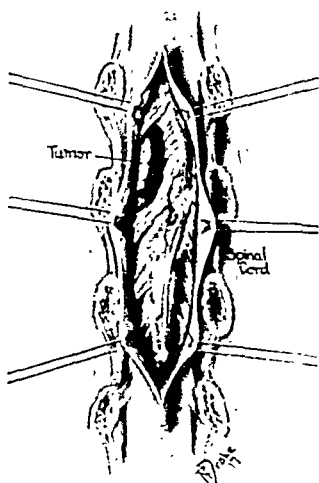


Fig. 283.—Enucleation of leptomeningioma. This was an anterolateral tumour situated between the seventh cervical and first thoracic vertebrae.

are exquisitely sensitive, and any undue handling or exposure rapidly gives rise to a severe degree of shock. This may be lessened by placing pledgets soaked in novocain solution around the cord above the tumour. Painful afferent impulses are thus interrupted, and these—according to the ‘anoci-association’ theory of Crile—are the most potent factor in the causation of shock.

When the dura has been opened it may happen that the growth is not at once apparent. In such cases it is probable that the lesion is at a higher level than the segment exposed. This point may be

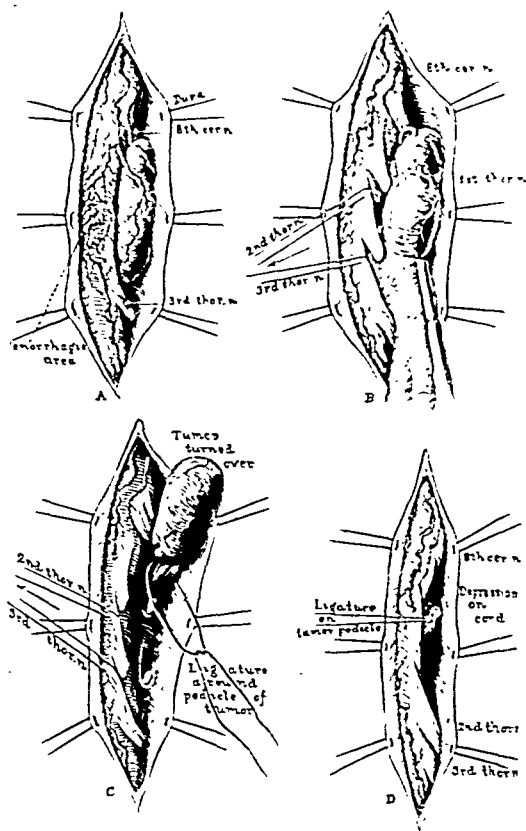


Fig. 284.—Stages in the enucleation of an anterolateral leptomeningioma. A. Exposure of growth; B. Division of spinal roots and rotation of cord, prior to the enucleation of the tumour; C. Elevation of the tumour to show the attachment of the pedicle to the dura; D. Appearance of the cord after removal of the tumour. Note the effect produced by the pressure of the latter

verified by injecting into the subarachnoid space between the third and fourth lumbar vertebrae 5.00 c.c. of a sterile 1 per cent solution of indigo-carmin in distilled water. If the tumour is below the area exposed, the dye will not readily appear about the cord. If the cerebrospinal fluid is tinted at once by the indigo-carmin, the incision should be extended upward

and the bony casing of the theca removed until the tumour is reached; rarely is it justifiable to pass even the softest of probing instruments up the canal in a blind endeavour to locate the obstruction.

When the growth is exposed it should be removed as far as possible in one mass by delicate blunt dissection with moist pledgets of wool. Care must be taken that it is not torn bodily from the important structures among which it is lying. In order to avoid this it may be necessary to remove the bulk of the growth

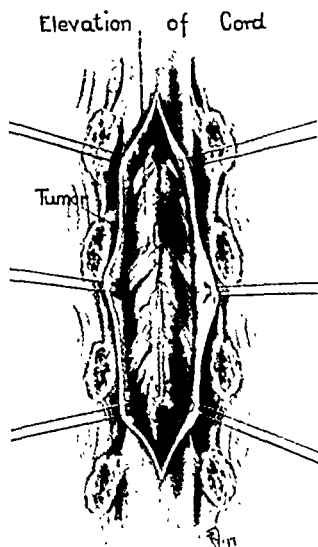


FIG. 285.—Bulging of the spinal cord, due to a leptomeningioma situated anteriorly.

piecemeal and to leave the removal of its capsule to the last. The most perfect hæmostasis is essential, and the subarachnoid space must be kept scrupulously free from blood. The sucker will be found most useful. Parenchymatous oozing may be checked by pressure or by applying small pieces of muscle to the bleeding surface. If it is found impossible to separate the growth from a nerve-root this should be carefully divided between fine ligatures, so that the segmental vessels passing to the cord are secured. Whenever possible adherent dura must be removed with the tumour by snipping round the latter with fine scissors; if the growth is ventral, this is not feasible because of sinuses in the dura; it may then be scraped with a spoon.

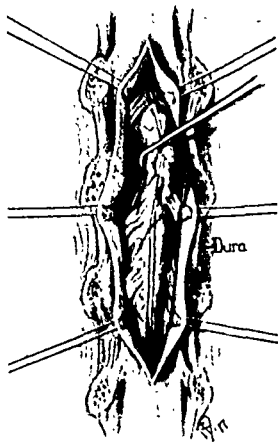


FIG. 286.—Showing depression made by anterior tumour, and the elevation of the cord necessary before enucleation of same is possible.

When the growth is exposed it should be removed as far as possible in one mass by delicate blunt dissection with moist pledgets of wool. Care must be taken that it is not torn bodily from the important structures among which it is lying. In order to avoid this it may be necessary to remove the bulk of the growth

Occasionally it is difficult to obtain adequate access to a ventral tumour. In such cases one of the slips of the dentate ligament may be divided close to its attachment to the dura. The slip is then grasped in mosquito forceps, and by gentle traction on these the cord is rotated a little, and a better exposure of the tumour is afforded.

Before the dura is closed the field of operation must be cleansed by gentle syringing with normal saline solution at a temperature of 99° F. until this returns clear. Any dural defect may be sealed with Cargile membrane or with a fascial graft. The utmost care should be taken to close the wound firmly in layers, in order to prevent a leak of cerebrospinal fluid.

After-treatment.—The after-treatment of these cases demands especial nursing care. The insensitive skin is particularly liable to break down at the pressure points, especially if it has been injured by the unwise application of hot-water bottles. Where there has been previous bladder trouble the viscus should be drained continuously by an indwelling catheter, which need not be changed oftener than once every three days. The exhibition of hexamine, combined when the urine is alkaline with the acid phosphate of sodium, helps to prevent or combat urinary infection, and lavage of the bladder with such a chemical as mercury oxycyanide (1–4000) should be carried out night and morning. When the patient regains control of the bladder the catheter may be removed. The rectum is best emptied by an enema every second evening.

XX. PROGNOSIS.

The prognosis in cases of leptomeningioma of the spinal cord may be considered under two headings: (1) *The question of operative removal*; (2) *The question of restoration of function in paralysed areas*.

1. **The Question of Operative Removal.**—It may be said at once that leptomeningiomas of the spine lend themselves readily to removal. Usually an intracapsular enucleation can be performed, and under these favourable conditions there need be no anxiety that the growth will recur. As has been mentioned, when occurring in the spine tumours of this type do not display even the local malignancy which is a feature of certain intracranial specimens. Anatomical relations make the removal of a high cervical growth somewhat hazardous, but this may be overcome to some extent by dividing the operation into two stages—first exposure, and later removal. In other situations there is a possibility that one or two nerve-roots must be sacrificed, but the resulting anaesthesia is trivial, unless it be necessary to divide all the roots arising from three adjacent segments. The removal of several contiguous spines and laminae does not appreciably weaken the vertebral column, unless the articular processes are encroached upon.

Of more importance is the general condition of the patient. His resistance is often lowered by a prolonged period of inanition, and frequently severe urinary infection is present. Pre-existing bed-sores may offer a portal for the entrance of infection, and his position in bed and paralysis preclude efficient ventilation of the lungs. On the other hand, it is remarkable how well these patients withstand the operation; in the Mayo Clinic series of 31 patients the immediate mortality was 9·7 per cent (3 patients). All deaths

occurred in advanced cases of the disease. One patient died of shock thirty-six hours after operation. He had had almost complete paraplegia for five months, and the cord at the level of the growth was about four-fifths of its natural size. One patient died twenty-four hours after operation. The tumour was high in the cervical region, and the cord was compressed to one-half of its natural size. One patient with complete paraplegia had had an unsuccessful laminectomy elsewhere a year before. This patient died of acute pericarditis.

2. The Question of Restoration of Function.—The degree of restoration of function after the careful removal of a leptomeningioma depends upon two factors: (a) The stage at which the operation is performed; and (b) The type of compression of the cord displayed. In early cases, where the conducting paths have not suffered severely, return of function is usually rapid and complete. In general it may be stated that where paralysis has been present for less than twelve months, at the very least some return of function may be confidently expected. A more definite opinion may be possible after the operation; as has been pointed out, a deep local indentation of the cord produces more permanent damage than does a longer flattening. Improvement is sometimes apparent immediately after removal of the tumour. It may be aided and hastened by careful massage, and it has been known to show itself first after so long an interval as eighteen months. Usually the first sign of recovery is the regaining of vesical and rectal control, if these have been impaired. Later there is a gradual return of muscular power, and finally sensation is restored to anæsthetic areas, although of all the functions of the cord the transmission of sensory impulses is the most likely to suffer some permanent damage. With the return of sensation trophic ulcers heal more rapidly. Reference has already been made to the possibility of the return of motor function even after a previously spastic paralysis has become flaccid, although such a favourable result is rare. On the whole it may be said with confidence that the operative treatment of leptomeningiomas of the spinal cord is equally gratifying to surgeon and patient.

XXI. CASE HISTORIES.

The following are the histories of five patients suffering from spinal leptomeningioma, whose examination and treatment I was privileged to follow at the Mayo Clinic. For the opportunity of doing so I am much indebted to Drs. Shelden and Adson of the Neurological Department.

Case 1.—High cervical leptomeningioma in a male, age 32. Extirpation (partial). Recovery.

HISTORY.—Four months previous to registration the patient began to have headache in the right parieto-occipital region, which radiated to the right occiput and neck. This was constant, reached its maximum intensity in the early hours of the morning, and abated about noon. At the same time he found that he had difficulty in starting the act of micturition, and that the stream of urine lacked force; and also that his bowels moved with increasing difficulty. A month later he noted that he could not move his left hand and arm as he wished, and a little later had the same difficulty with his left foot, so that he became unsteady when walking. There was also a slight ache along the inner border of his left arm. For two months he had had analgesia and thermanæsthesia of the right arm, right side of the body,

and right leg; this was accidentally discovered as he was taking a warm bath. Atrophy of the nuchal muscles on the left side was observed six weeks previously, and for the same time there had been a tingling sensation in the right hand, beginning in the fifth finger. There had been some twitching movements of the left index finger, and the left arm became flexed when he yawned (p. 434). For two months the headache had been accompanied by vomiting, which was not associated with nausea.

ESSENTIAL NEUROLOGICAL FINDINGS.—The right pupil was larger than the left. The optic fundi were normal. The muscles on the right side of the body were normal. On the left side the muscles were paralysed in the following degrees: * Interossei, — 3 — 4; thenar and hypothenar, — 2 — 3; flexors and extensors of arm, — 2 — 3; supinators and pronators, — 3 — 4; abdominal muscles, — 2; muscles of leg, — 1 — 2. Tonus in these affected muscles was $\div 1 \div 2$. The left nuchal muscles were atrophied, $\div 2$.

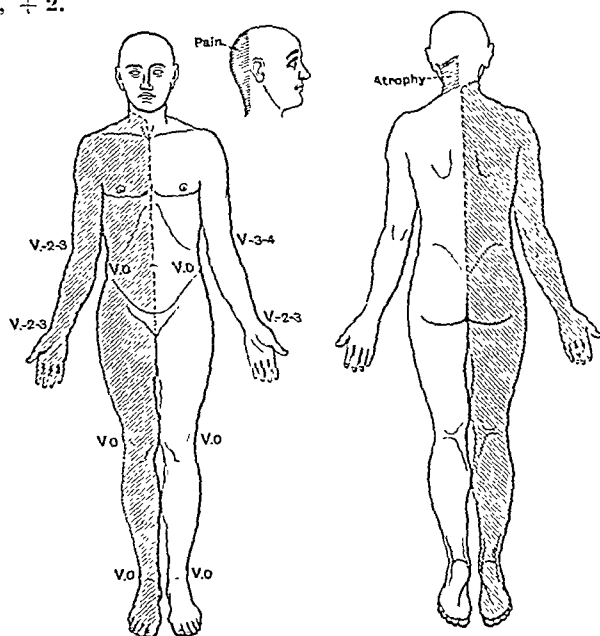


FIG. 287.—Case 1. Sensory findings. There was complete analgesia and therm-anesthesia over the shaded area. V, Vibratory sense.

All the tendon-jerks of the left arm were increased $\div 2 \div 3$, as were also the jerks of both right and left legs. On both sides the great toe was dorsal-flexed on stimulating the sole of the foot. The abdominal reflexes were absent on both sides. The gait was slightly spastic, the left leg being specially affected. There was some dysdiadochokinesia and dysmetria of the left arm.

Loss of perception of painful and thermal stimuli was complete over the right side of the body, below the level of the cutaneous cervical nerve. Tactile sense was intact. The sense of vibration was normal in the pelvis and lower extremities, but was diminished — 2 — 3 — 4 in the arms. (Fig. 287.)

* In the Mayo Clinic the degree of all processes is graded from 1 to 4. Thus — 4 would indicate complete palsy of a muscle; $\div 2$ a moderate increase in tonus; — 1 a slight blunting of sensation. For the normal condition 0 is used. This system will be adhered to throughout these case reports.

OPERATION.—Under paravertebral anaesthesia Dr. Adson removed the spines and laminae of the upper four cervical vertebrae, and part of the occipital bone. The tumour was dorsolateral and was situated opposite the first cervical root on the left side. It measured $3 \times 2 \times 1$ cm., and when removed exposed an area of about 15 mm. diameter, ? a cross-section of an intramedullary portion. This was not excised. The patient had an uneventful convalescence.

Case 2.—High cervical leptomeningioma in a male, age 25. Extirpation. Death eleven weeks later from internal hydrocephalus and hydronephrosis.

HISTORY.—Ten years previously the patient had had an injury to the back, between the shoulders. At that time the back was painful for six to eight weeks. The following year the pain recurred, but thereafter he was well for seven years. Then he began to have aching pain in the left shoulder and forearm, which was accompanied by a feeling of numbness in the fingers of the left hand and in the left forearm. This was followed by a slow progressive spastic weakness of the left arm.

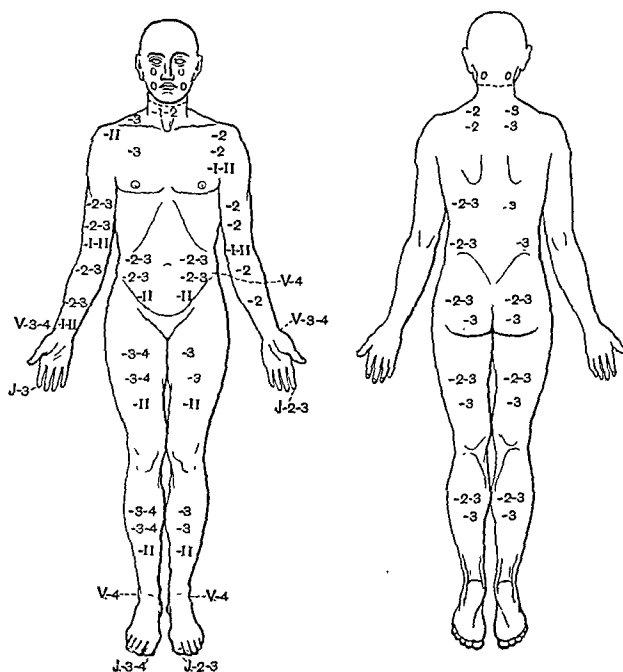


FIG. 288.—Case 2. Sensory findings. Black Arabic, Tactile; Red Arabic, Pain; Red Roman, Temperature; V, Vibratory sense; J, Joint sense.

Six months later the pain became very severe, and now radiated to the left side of the neck, and down the left arm to the fingers. About eight months after the beginning of the illness he noted some loss of strength, loss of control, and awkwardness of the left leg, together with a numb feeling in this extremity. Twelve months later the right arm and leg became similarly affected, while the condition of the left arm and leg improved somewhat. Recently on one or two occasions he had lost control of his urine, and his bowels had become increasingly constipated.

ESSENTIAL NEUROLOGICAL FINDINGS.—The muscles of both arms were weakened, those of the right - 2 - 3, those of the left - 2. All the muscles of the right lower extremity were weak (- 1 - 2), and there was a similar degree of weakness of the muscles of the left pelvic girdle. The tendon-jerks were increased in both arms (+ 1 + 2) and both legs (right + 2 + 3, left + 3 + 4). The abdominal reflexes were absent. On both sides the great toe was dorsiflexed on stimulating the sole

of the foot. The gait was spasmodic, and inco-ordination and dysmetria were marked on both sides.

Below the level of the cutaneous cervical nerve there was loss of perception of all forms of sensation, which varied in intensity from - 2 in the arms, - 2 - 3 over the trunk, - 3 in the thighs, to - 3 - 4 in the legs. The details are shown in *Fig. 288*. Examination of the cerebrospinal fluid revealed the Nonne syndrome, no xanthochromia, and a very slight response to jugular pressure.

OPERATION.—Under paravertebral anæsthesia Dr. Adson removed the spines and laminae of the upper four cervical vertebrae. The tumour was dorsolateral, 30 × 15 mm., and situated opposite the second and third cervical vertebrae. It was removed with some adherent dura. Three weeks after operation the patient suddenly developed right hemiplegia with aphasia, and died two months later. The post-mortem examination showed internal hydrocephalus and hydronephrosis.

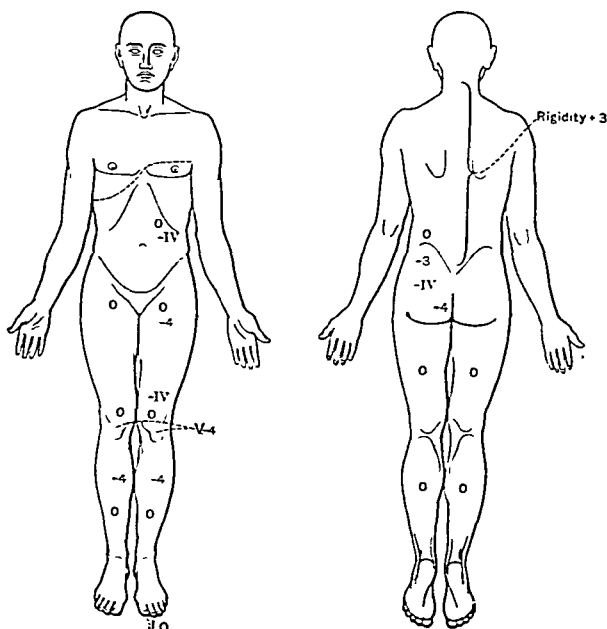


FIG. 289.—Case 3. Sensory findings. Black Arabic, Tactile; Red Arabic, Pain; Red Roman, Temperature; V, Vibratory sense; J, Joint sense.

Case 3.—Upper dorsal leptomeningioma in a female, age 48. Extirpation. Recovery.

HISTORY.—For four years the patient had felt pain in the third and fourth intercostal spaces, radiating from the back round to the left breast. The pain was worse if her spine was jarred, and also in the morning on getting up. After three years this pain became very severe, and she also felt pain up and down the whole dorsal and lumbar regions in the muscles on either side of the spine, which eventually became so rigid that she was unable to tie her shoes. For some months she had been spending her nights alternately walking and sitting, in an effort to obtain relief from pain, and she had lost a good deal of sleep. Eleven months previous to her registration she had a series of plaster casts applied to the spine elsewhere. The casts were uncomfortable, especially when she was lying down. Her worst pain was in the morning on first rising, and at night she had throbbing pain round the third intercostal space under the axilla to the left breast; frequently she had to leave her bed and walk about.

Six months previously she began to feel better, and four months later she had the last cast removed. A few hours after its removal she noticed a numbness across her abdomen which had not been present before. That night she had little pain, but she noted her legs were also numb. In the morning her old pain had returned, the numbness had extended to the feet, and her legs were 'not working properly'. These features had remained stationary; her pain was readily started by jarring movements of the spine and by coughing and sneezing. There had been no sphincteric disturbances.

ESSENTIAL NEUROLOGICAL FINDINGS.—There was no muscular paralysis. The tendon-jerks on both sides of the body (arms and legs) were increased $+1$ \div 2 , and there was a bilateral dorsal response of the great toe on stimulating the sole of the foot. The abdominal reflexes were absent. Romberg's test was positive. The tactile sense was normal, but below the level of the fourth rib on the left side and the sixth rib on the right side there was complete analgesia and thermanæsthesia.

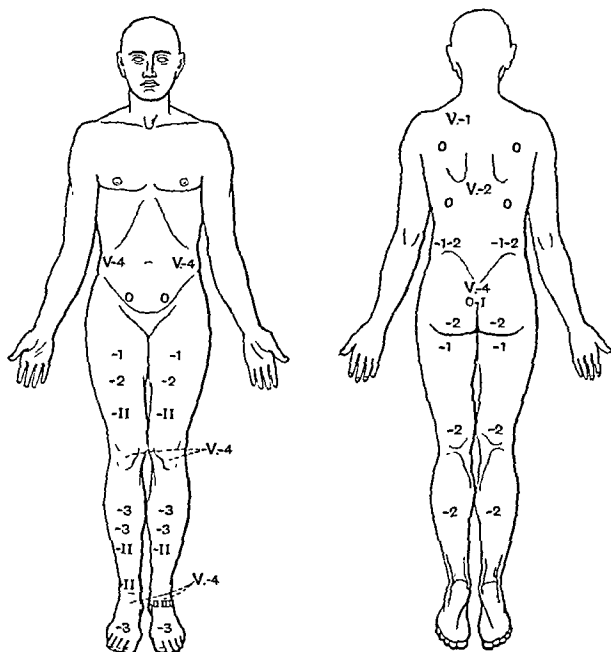


FIG. 290.—Case 4. Sensory findings at first examination. Black Arabic, Tactile; Red Arabic, Pain; Red Roman, Temperature; V, Vibratory sense.

The joint sense was normal in the legs. The details are shown in *Fig. 289*. Examination of the cerebrospinal fluid revealed a normal colour, no increase of protein, and a poor response to jugular compression.

OPERATION.—Under paravertebral anaesthesia and a little ether Dr. Adson removed the spines and laminae of the upper six dorsal vertebrae. The tumour was found on the left anterolateral aspect of the cord, opposite the fourth and fifth dorsal vertebrae. It was fusiform, 4×2 cm. in size, and it had compressed the cord to half its normal size. It was attached to the dura in the vicinity of the point of exit of the fourth dorsal nerve-roots. It was removed completely. Convalescence was uneventful.

Case 4.—Mid-dorsal leptomeningioma in a female, age 65. Diagnosis at first obscure. Tumour removed later. Recovery.

HISTORY.—This patient first registered at the Mayo Clinic two years previously. For six years she had had weakness of both lower extremities, with tingling and

numbness. Three years later the weakness began to progress, and there were occasional spasms of the muscles of the legs. During the whole of the illness there had been some difficulty in controlling the bladder, and for the last year and a half this had been markedly increased. A year previously she began to have a 'girdle sensation' around the lower abdomen, and this was still present. Six months later pain appeared. At first this came on in the early morning, and was relieved if she got up and sat in a chair. Lately it became progressive and was felt by day as well as by night. There were two painful areas: one just to the right of the umbilicus, crossed by the 'girdle sensation' and about the size of the palm of the hand, and another about two inches in diameter over the right sacro-iliac joint.

ESSENTIAL NEUROLOGICAL FINDINGS.—There was slight weakness of the muscles of both lower extremities ($-1-2$). The tendon-jerks in these were increased ($+1+2$), and there was a marked bilateral dorsal response of the great toe on stimulating the sole of the foot. The abdominal reflexes were absent. The gait

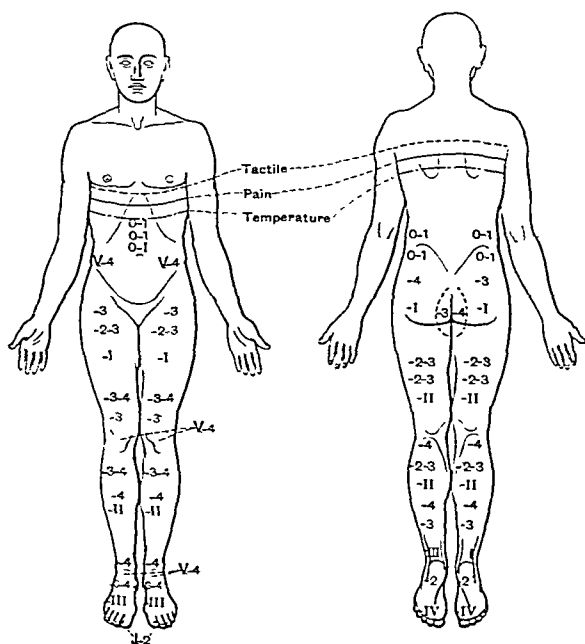


FIG. 291.—Case 4. Sensory findings at second examination, two years after Fig. 290. Black Arabic, Tactile; Red Arabic, Pain; Red Roman, Temperature; V, Vibratory sense; J, Joint sense.

was ataxic, and Romberg's sign was positive. The sensory changes are best studied from Fig. 290.

DIAGNOSIS.—The diagnosis lay between hypertrophic arthritis of the dorsal spine, arteriosclerosis of the central nervous system, and tumour of the cord. Exploratory laminectomy was advised but declined.

SUBSEQUENT HISTORY.—After leaving the clinic the weakness and numbness of the legs increased, and the 'girdle sensation' became crushing in type. She got about on crutches. Two years later, when she was re-examined, she had continuous aching pain in both lower extremities, worst at the joints. Four months previously her legs had given way and she had sprained her ankle; she had not been able to walk or stand since.

The weakness in the muscles of the lower extremities had increased to $-3-4$ on the right side and to $-2-3$ on the left side. The reflexes were as before. A

definite sensory level was now present (*Fig. 291*), and these findings should be compared with those of two years previously. The cerebrospinal fluid was clear, and responded but poorly to jugular compression.

OPERATION.—At the laminectomy, performed under local anaesthesia, Dr. Adson found an anterolateral tumour opposite the seventh dorsal vertebra, 2 cm. in diameter. The cord was reduced to one-third its normal size. Convalescence was uneventful.

Case 5.—Low dorsal leptomeningioma in a female, age 50. Extirpation. Some improvement.

HISTORY.—Seven years previously, in the spring, the patient began to suffer from severe pain in the left hip, especially after lifting a weight or after a hard day's work. Later this pain spread down to the posterior aspect of the left knee, and finally to the left foot. By the following summer the condition had cleared up,

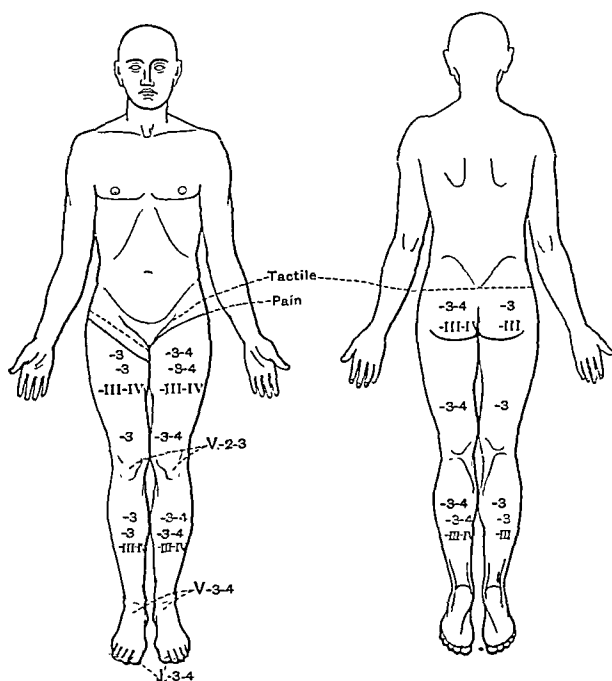


FIG. 292.—Case 5. Sensory findings. Black Arabic, Tactile; Red Arabic, Pain; Red Roman, Temperature; V. Vibratory sense; J. Joint sense.

but in the autumn the pain returned with greater severity. A year or so later she developed dull pain in the left upper quadrant of the abdomen; at times this radiated to the back on the same side. Five years previously, while the hip pain was still present, she noted weakness and loss of control of the left leg, and at the same time she began to suffer from pain in the right hip. Three years later the paralysis had increased to such an extent that she lost the use of both legs. For two or three years she had had difficulty in starting the flow of urine, and also progressive constipation.

ESSENTIAL NEUROLOGICAL FINDINGS.—There was weakness of the muscles of the pelvic girdle on both sides (— 2 — 3), and complete paralysis of the remaining muscles of the lower extremities (— 4). The tendon-jerks of the legs were increased, and there was bilateral dorsal flexion of the great toes on stimulating the soles of the feet. The sensory changes were as shown in *Fig. 292*. The cerebrospinal fluid

showed xanthochromia, increased protein content, and no response to jugular compression.

OPERATION.—Dr. Adson removed the spines and laminae of the dorsal vertebrae from the eighth to the twelfth. The tumour involved the eleventh and twelfth dorsal posterior nerve-roots, measured 2×1.5 cm., and had compressed the cord to one-third its normal size. Convalescence was uneventful, but improvement slow. One month after operation the sensory paralysis was a little better, but the urine was less easily controlled.

Mr. Irish, photographer at the Mayo Clinic, is responsible for *Figs. 231–237, 271, 272, 283–286* (all pre-existing photographs which were suitable), *227–229, 238, 239, 241–250, 252–256, 264, 267* (sections prepared by me to illustrate this paper, from material provided by the Mayo Clinic), and *258, 259, 261, 263, 266* (from material obtained from an experiment I made upon an animal). Mr. Kirkpatrick, of the Pathological Department, Glasgow University, photographed the remainder. *Figs. 226, 240, 251, 260, 262, 269, 270* are from sections I prepared from material provided by the Mayo Clinic. *Fig. 230* is from Dr. Frazier's book, *Surgery of the Spine and Spinal Cord* (Appleton). *Fig. 257* is a diagram I modified from a figure by Professor Elliot-Smith. *Figs. 265* and *268* are from the experiment mentioned above. *Fig. 273* I constructed from data in a paper by Mr. Barrington. *Figs. 275–280* I constructed from notes of a lecture by Dr. Stookey. *Fig. 281* is from a paper by Drs. Cushing and Ayer, and *Fig. 282* is from a paper by Dr. Lévy-Valensi. For the sections from which *Figs. 267, 269, and 270* are taken I am indebted to Dr. J. W. Kernohan, Neurological Pathologist to the Mayo Clinic. For the use of the remaining pathological material, with the exception of that obtained from an experiment upon an animal, my thanks are due to Dr. H. E. Robertson, Pathological Anatomist to the Mayo Clinic.

Dr. F. C. Mann, Director of the Experimental Laboratory, Mayo Clinic, kindly gave me facilities for obtaining fresh material to illustrate the histological appearances in compression of the cord. Under ether anaesthesia and aseptic technique I removed the spines and laminae of the sixth and seventh dorsal vertebrae of an adult dog. I then pushed a cylinder of bone wax, measuring 1.5×0.5 cm., between the arch of the fifth dorsal vertebra and the dura, and closed the wound in layers. After a period of six weeks, during which the animal gradually developed total anaesthesia below the level of the ninth or tenth dorsal segment, it was again anaesthetized. I now removed the cord for a length of 4 cm. above and below the site of compression, while the dog was alive; in this manner the circulatory phenomena were well preserved. Suitable lengths of cord were then fixed at once in several reagents, according to the manner in which they were to be stained. The animal was killed while under the anaesthetic.

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RANULA.

By DUNCAN C. L. FITZWILLIAMS, C.M.G., LONDON.

RANULA is a loose term inherited from bygone days, distributed widely over the world, and one which we shall probably never be rid of; but it is a term in medicine which cannot be defined and has no scientific meaning. It has been applied to all cystic swellings of the floor of the mouth whatever their form or origin. Dermoid swellings, swellings in connection with calculi of the salivary glands, acute swellings, traumatic swellings, parasitic swellings, swellings below the jaw, and even below the hyoid bone in connection with the thyroid gland, have all been included under the term ranula.



FIG. 293.—Cat with ranula (Hobday).

The actual connotation of the term ranula even is uncertain—whether it refers to the croaking voice caused by the tumour likened to that of a frog, as some assert, or refers to the glistening appearance of the tumour which resembles the belly of the frog, as Charles Bell thought, is unknown. Some have thought the swelling is like the head of a little frog, the openings of Wharton's duct being its eyes, and others again have likened the glairy fluid evacuated to the jelly-like substance in which the eggs of the frog are found. Ranulae are found quite commonly among the lower animals (Fig. 293).

Many attempts have been made to confine the term to certain swellings, but none have succeeded. Many attempts have been, and are still being, made to attribute all forms of ranulae to one cause. Fleischmann thought he had

discovered a bursa which he said was the one and only cause of ranulae; other observers, like Recklinghausen, suggested that the origin of all ranulae was Blandin's gland, and lately Thompson published a paper in the *Annals of Surgery* describing as the one and only cause a persistence of the cervical sinus in connection with the branchial clefts. There is no one and only cause of these swellings. Cases will be quoted to show that ranulae may take origin in the mucous glands, the sublingual gland, Blandin's gland, and in the submaxillary gland. There is a large class of ranulae which I suggest may

start in one or other of these organs, but in which one at the moment is doubtful. These are ranulae with more or less extensive prolongations to the neck or face.

CYSTIC SWELLINGS OF THE MUCOUS AND OF THE SUBLINGUAL GLANDS.

These we must take together, as we are unable to differentiate them. There is no reason we know of why the mucous glands, which are numerous under the tongue, should be more liable to become cystic than they do elsewhere. On the other hand, we see them cystic frequently upon the lips and cheeks, and very seldom on the dorsum of the tongue. The tissues under the tongue are soft and lax, and therefore we may suppose that the cysts are liable to attain a larger size here than they do elsewhere. Lockwood published the following case, which must have originated in a mucous gland, as there was no salivary action found on carefully testing the fluid :—

Case 1.—A girl, age 14, had a typical ranula below the right side of the tongue which had been noticed for two months. The salivary ducts were free and discharged saliva. A piece was snipped from the wall and 2 drachms of the contents, which were a tenacious, yellow, transparent fluid, slightly alkaline, were saved. The fluid was soluble in distilled water, and became white and opaque with precipitate on the addition of acetic acid. Perchloride of iron produced no claret reaction, so that no sulphocyanide of potassium was present. Added to starch and kept for some time at a gentle heat, no conversion into glucose was obtained. It appeared to consist of pure mucin. It seemed probable that the cyst was a distended sublingual mucous gland.

Many of the cysts, however, are not of this character, and are probably due to distention of one of the ducts of the sublingual gland. Claude Bernard made cysts experimentally by obstructing the duct of Rivinus, and the work of Suzanne showed that the ducts of the sublingual gland were very irregular. Baker in 1871, at a time when all ranulae were supposed to originate in the dilatation of Wharton's duct, drew attention to the fact that in many cases a probe could be passed along this duct, which had nothing whatever to do with the swelling. He reported in detail five cases in which the fluid of the ranula was nothing like submaxillary saliva. He also stated that obstruction of Wharton's duct produced symptoms quite unlike those of a ranula. His cases may have originated from obstruction to some of the ducts of the sublingual gland. Many of the cysts found in this region are undoubtedly of this origin. This form of ranula appears as a small glistening tumour under the tongue, and is so familiar to everyone that no ordinary case need be quoted. Weeden Cooke reported one which seems to have been peculiar :—

Case 2.—An old woman had had a ranula for many years, which had grown to be the size of an orange. If she kept it in her mouth it protruded one cheek in the most unsightly manner, and when allowed to hang out of the mouth it was like a transparent jelly-bag. She was able to talk and eat with but slight inconvenience. She steadily refused all operations, from snipping out a piece of the wall to touching it with potassa fusa.

If a piece of the wall of these cysts is examined under the microscope, mucous or secreting membrane is always found. No case has been reported

in which the cyst was lined with endothelium. This is important in view of the statements made from time to time that these cysts originate in a bursa in this neighbourhood.

CYSTS OF BLANDIN'S GLAND.

Blandin's gland is small and not of great importance. Only a few cysts of this gland have been reported. Eve noted one as follows:—

Case 3.—A ranula from the walls of which projected small glands of mucous structure. The fluid was very viscid, and gave no reaction to the tests for sulphocyanide of potassium. It had no connection with Wharton's duct.

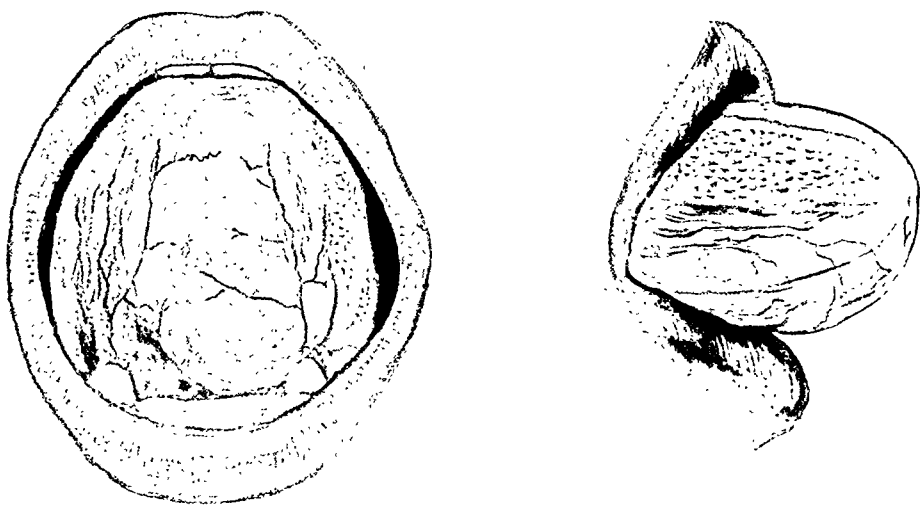
He thought that this cyst was the ordinary type of ranula.

Von Recklinghausen reported a similar case as a cyst of Blandin's gland.

Curtis reported:—

Case 4.—A woman of 25, who had noticed a swelling for four months near the tip of the tongue on the left side. This disappeared, but soon afterwards a similar swelling appeared upon the right side. The tumour was elastic, purplish, 1 in. long by $\frac{1}{2}$ in. broad. It was aspirated through a thick needle, but nothing came out. On incision, mucous fluid was obtained. It was fully opened, and the lining membrane was sewn to the mucous membrane.

(Figs. 294, 295.)



FIGS. 294, 295.—Curtis's case, made from a coloured drawing in Greenwich Hospital.
(By kind permission.)

Ramon Tejada Aguirre also reported one:—

Case 5.—The patient, 13 years old, had a congenital tumour at the tip of the tongue measuring 6 by 4.5 by 3.5 cm., slightly fluctuant. Aspiration drew some thick, white, viscid fluid, without odour, and with the characteristics of mucous fluid. Only liquid and soft food could be taken; mastication was impossible. There was marked hyperthesia of the tongue in the region of the tumour, especially when the warm fluids were taken. The patient suffered from attacks of suffocation during sleep. It was diagnosed as a cyst of Blandin's gland. The mass was removed and recovery followed.

A congenital case was reported by Foderl in a stillborn child who had a large cyst near the tip of the tongue.

RANULÆ IN CONNECTION WITH THE SUBMAXILLARY GLAND.

The submaxillary being the largest and most important gland in the region, it is not surprising to find that it gives rise to many clinical conditions related to ranula. There are congenital ranulæ, acute ranulæ, traumatic ranulæ, and ranulæ due to the gradual occlusion or blocking of Wharton's duct.

Congenital Ranulæ.—In former days many dermoid cysts were included as congenital ranulæ, but I have eliminated these. Dr. Muller, in a paper read before the Moscow Medical Society, said that among 80,000 children observed in the Moscow Foundling Hospital only four or five cases of congenital ranulæ were known. The condition therefore is rare, and only about twenty cases have been known; but doubtless many cases have not been published. One came under my notice at Paddington Green Children's Hospital not long ago. In nearly every case there has been either a complete or a partial occlusion of the termination of Wharton's duct. In most cases the child has been unable to take the breast, probably on account of the pain incommoding the movements of the tongue; in one case the child died soon after birth, so that the condition could be investigated. The following excellent example may be quoted:—

Case 6.—A boy 3 weeks old, in whom a small tumour had been noted soon after birth; sometimes there was difficulty in suckling, swallowing, and breathing. The swelling was transparent, and crossed the frænum slightly. There was no trace of Wharton's duct upon the right side, and the submaxillary gland upon that side was swollen. The opening of the duct was present on the left side. The tumour was situated along the course of the duct. (Guinard.)

Stolts's case was as follows:—

Case 7.—"The point of the tongue was lifted and directed to the right side by a whitish transparent tumour on the under surface of the frænum, which was obliterated." "The infant cries whenever it takes the breast, the voice is altered, and there is difficulty in breathing."

Other cases have been recorded by Richer (two cases), by Lannelongue (whose case died), Guyon, Blot, Panas, Giraldès (three cases), Guéniot, and Deschamps. In the last a jet could be expressed from the mouth of the duct by pressure on the floor of the mouth. The cyst was opened and a horsehair passed into it through the narrowed opening of the duct. In Lombard's case the child's face was violet-coloured and the tumour actually protruding from the mouth. The cyst was punctured and the child relieved.

In the *Bull. Gén. der Thérapeutique*, 1862, lxiii, 316, two cases of congenital ranula are mentioned; in one of which there was a bluish swelling under the tongue and the child refused the breast, but it swallowed well from a spoon. The child took the breast at once after the swelling had been punctured.

In most of the cases it was evident that Wharton's duct was blocked, closed, or stenosed, and did not admit the passage of saliva even when citric acid or vinegar was placed upon the tongue. Other congenital cases, however,

are recorded in which the origin of the tumour has not been so evident. Stephen Paget reported one of the best examples under the heading of "Congenital Cyst under the Tongue" (*Figs. 296, 297*) :—

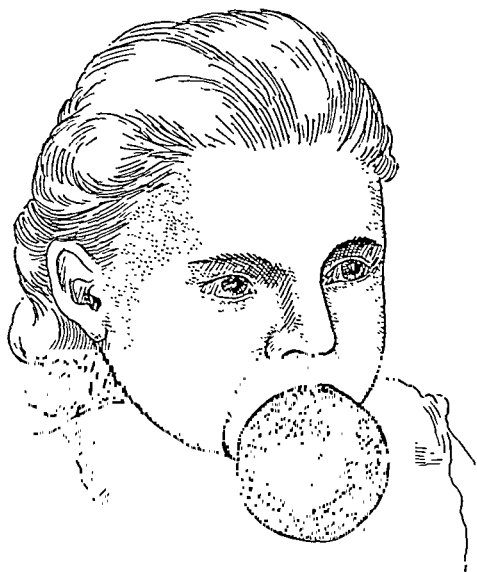


FIG. 296.—Large congenital cyst under the tongue. (*Stephen Paget's case.*)

Case 8.—The child at birth was nearly suffocated, and the cyst so protruded from the mouth as actually to make delivery difficult. It was tapped at once, and nearly a tumblerful of clear watery fluid was drawn off. It was tapped twenty times in the first year, as further operative procedures were refused. The child was now four years old. The cyst hung out of her mouth, almost touching the sternum, and jerked up and down with the movements of the tongue when the child swallowed and talked. It was covered with a dry cuticle as thick as the skin, the lips were everted and the jaws deformed, the front teeth looked forwards and downwards. The cyst was removed. It contained some ounces of turbid yellow fluid. The wall was simple fibrous tissue with no trace of epithelium. It was therefore not a dermoid, and the thick fluid showed that it was not a hygroma of the neck.

Butlin classes this case as a cyst of the incisive gland, but on what grounds is not stated. The incisive gland is only an inconstant collection of mucous glands.

Acute Ranula.—These are swellings which seem to be formed in connection with the submaxillary gland. They come on rapidly and without obvious reason. A swelling suddenly forms in the floor of the mouth, pushing the tongue to the opposite side and rolling it upwards and backwards, till it is almost lost to sight. The swelling is accompanied by great pain. Breathing is very difficult, and the patient may become cyanotic. The friends and onlookers are alarmed, and the patient becomes nervous and agitated, as there seems every likelihood of the swelling increasing till suffocation takes place. The cause of the condition is some sudden block to the outflow of the saliva, and may occur as the result of the blockage of the duct by a stone. All cases, however, which can be attributed to calculi have been eliminated from consideration here. Blockage, however, may occur from less obvious causes, many of which have escaped notice, but probably most are due to inspissation of mucus in the secretion.

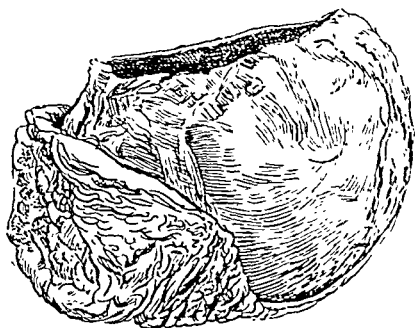


FIG. 297.—The cyst shown in *Fig. 296* after removal.

This is well illustrated in the case reported by Buzby :—

Case 9.—A man, age 34, while eating lunch had a sudden and violently painful swelling appear in the left submaxillary region. It was so severe that he could not continue eating, and he was slightly nauseated. He was examined within half an hour, when a greyish granular plug 2 mm. in diameter was seen protruding from Wharton's duct; the gland was swollen and exquisitely tender. This granular material was removed, and was followed by a gush of saliva. Next day the tenderness was less, but there was a slight amount of detritus protruding from the duct.

Du Cane reported a case in which he sought diligently for a cause but could find none :—

Case 10.—A man in excellent health had just begun dinner when suddenly his mouth was filled up with a tumour which formed beneath his tongue, and increasing rapidly in size pushed his tongue backwards so that only the under surface of the tip could be seen. Two large pinkish swellings were visible in the floor of the mouth. The patient could neither speak nor swallow, had severe dyspnoea, and thought he was going to suffocate. No stenosis nor salivary calculus of the duct could be found. An incision was made, and immediate relief given on the exit of one and a half ounces of saliva. No other cysts or any signs of calculus were found, and there was no return of the symptoms.

The relation this sudden blocking bears to calculus is shown in Johnston's case, which is as follows :—

Case 11.—Mrs. C. M., complained of a sudden severe pain in the mouth and tongue. She could open her mouth only with difficulty, and could scarcely protrude her tongue. Under the tongue was a soft, rounded mass at the opening of Wharton's duct. Incision into this was followed by a gush of pus and the ejection of a semi-solid mass which proved to be a small stone surrounded by a substance resembling cooked macaroni.

Other similar cases have been reported by Bogros and in the *Dental Cosmos*, 1916; the *Clinical Journal*, July, 1907; and the *Deutsche Monatschrift für Zahnheilkunde*, 1908, 316.

Bouchard reported three curious cases. In one a woman felt her mouth suddenly filled by a tumour after drinking a glass of wine, and was soon in imminent danger of suffocation. The second was a man whose mouth filled in the same way while he was at a meal, and the third a woman in whom a tumour like the finger of a glove appeared rapidly below her tongue. In the last case, however, the same thing had occurred three times previously during eating, and all pain had passed off when eating was stopped, so that the cause, we strongly suspect, was a calculus.

Tilleaux mentions three similar cases which he ascribed to the enlargement of Fleischmann's bursa, into which he thought the duct of Wharton had burst: a worker who went to bed well but woke at 3 a.m. with the 'instantaneous formation' of a tumour under the tongue which menaced him with asphyxiation; a cook while performing her duties, and a woman who was sitting by the fire, were all suddenly attacked in the same way. The members of the medical society before whom Tilleaux exhibited the specimen showing the bursa, said that the space was only an artefact in areolar tissue, and plainly indicated that they did not believe that such a bursa existed.

Morestin mentions an unusual case of sudden enlargement of a ranula which had been present, and small, for five years or more. The man then

contracted syphilis and was treated with large doses of mercury ; he developed a stomatitis, and the swelling rapidly grew larger. It was removed.

Traumatic Ranula.—This is a swelling which results from the blocking of Wharton's duct either by a membrane or by a swelling, the result of bruising or trauma. The formation of leucoplakia may also be included here. It does not seem to be important, and an example of each will suffice. Richet notes blocking of the duct by a membrane :—

Case 12.—A young woman came with all the symptoms of ranula, and a swelling on the left side of the floor of the mouth. It was thought at first that she had osteitis of the jaw due to a bad tooth, but further examination showed that there was a dense resistant membrane on the floor of the mouth completely blocking Wharton's duct, from which no flow of saliva was visible.

French reports a traumatic case :—

Case 13.—A schoolboy, age 11, was sent to the doctor by his teacher for a 'gumboil'. One week previously, while eating a very hard apple a piece pressed on the floor of the mouth and caused him pain, and a lump appeared in a few minutes which precluded further mastication. There was a tense, cystic, transparent, irregular swelling about the size of a large walnut, below and to the right of the frænum close to Wharton's duct. The surface had small blood-vessels branching in all directions. A seton was passed, which evacuated the viscid contents.

Erichsen mentions a case where the slipping of a pair of forceps wounded the floor of the mouth in the vicinity of Wharton's duct and the saliva accumulated in the form of a cyst.

A case due to leucoplakia occurred in St. Mary's Hospital :—

Case 14.—H. R., age 50, had noticed for the last nine months a whitish patch growing under his tongue.

On admission a small patch of leucoplakia was seen in the region of the frænum on the right side. This patch was removed with scissors, and he left the hospital. Six months later he was readmitted with a history that he had had a swelling for the last four months under the tongue. A bluish white ranula was seen on the right side. It was dissected out.

Curious as it may sound, foreign bodies have found their way by accident along Wharton's duct and blocked it. In old-standing cases a deposition of lime salts has taken place upon them, causing calculi. Thus Closmadeduc reported a case where a piece of straw was found protruding from the duct. Bouillet mentions a man who was ill for nearly three weeks with pain and swelling of the tongue, in whom daily probing of Wharton's duct gave relief to the symptoms, as each time saliva was let out. At the end of this time an incision was made and a piece of straw found. There is the case of a soldier in whom a whole spikelet of corn was found in the duct, a central axis with four small leaves attached by thin pedicles, upon which lime salts had begun to be deposited.

Hulke reported a case with calculi in which the primary calculus was formed round a splinter of wood.

Delery and an Italian writer whose reference is lost both noted cases where a stone had been formed round a fish-bone ; Moure and Soupault record a case where it was round the bristle of a toothbrush ; Claude reported a tailor who had a pig's bristle in his duct.

LARGE BILOCULAR AND BURROWING RANULÆ.

I have classed the ranulæ which I am about to describe under the above headings, as it is difficult if not impossible to define them. Their nature is uncertain, and except their description, little is known about them. They are ranulæ which emerge from the mouth, spread to the face, the fauces, or the neck, to such an extent that the small tumour of the mouth appears negligible beside the huge tumour in the neck or face, and the extension becomes the most important, as well as the largest part of the condition. In some cases the floor of the mouth cicatrizes and no swelling forms, there being merely a small outlet to the swelling of the neck. It is only after careful study that any idea is obtained of their range, growth, relations, and extent. It appears that most of the theories as to their origin have been propounded after one or at most two curious cases have been met with, and so many theories have been suggested that one rather hesitates to give one's own view.

It is possible and even probable that they all start in the sublingual region as ordinary ranulæ. Some may start in the mucous glands, some in the sublingual gland, and some in the submaxillary gland. It is useless, however, to dogmatize upon this, and it is more worth while to lay the evidence in favour of this happening before the reader.

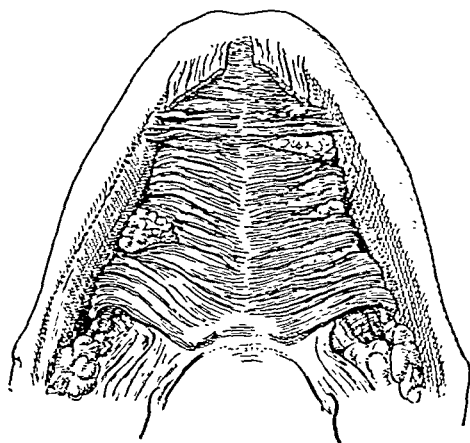


FIG. 298.—Dissection of the mylohyoid muscle showing prolongations of the sublingual gland through the muscle. Two other dissections were published illustrating the same thing (*Morestin*).

From the cases already recounted to illustrate the other features of ranula, it is obvious that a bulging below the chin may take place, though the tumour may not be below the mylohyoid muscle. In acute and congenital ranulæ, swelling of the submaxillary gland has been noted. Morestin has shown by careful dissection that the sublingual gland often protrudes naturally through the fibres of the mylohyoid muscle as a sort of hernia (*Fig. 298*). This gland too has no capsule, and is therefore in a position to be dilated. These being the facts we can trace the gradual extension of tumours which were obviously sublingual ranulæ to begin with to below the chin, into the neck, and so approach the rare and astonishing cases which have been placed upon record, where the extension has overhung the sternum.

In order to establish this gradual extension quite clearly I shall quote the following cases :—

Case 15.—A girl, 7 years old, had a small tumour under her tongue which steadily grew larger until it was the size of a nut. It was situated under the frenum, bilobed, fluctuating, with thin and transparent walls. It pushed the

tongue upwards. It was a sublingual ranula, as salt upon the tongue caused saliva to flow from Wharton's duct. The anterior wall of the cyst was removed. Six months later there was a tumour the size of a mandarin orange under the chin, with a little tumour in the mouth. There was a communication between the two. The tumour had begun to form three months after the last operation. Both tumours were dissected out.

Carp gives a similar case :—

Case 16.—A woman, age 29, who had a ranula under the tongue on the left side in January, by July had an extension into the neck. The tumour under the tongue was excised, and the swelling in the neck disappeared. Two years later there was a recurrence in the mouth, which was operated upon and was only cured for three weeks. There was now a swelling in the mouth and one in the submaxillary and cervical regions. The tumour in the neck was elastic and fluctuating, and pressure upon it caused increase in the size of the ranula. The ranula was opened, and a probe passed through its cavity into the neck for four inches; eight ounces of fluid were evacuated. Two days later the swelling in the neck returned and was opened, and the interior was swabbed with pure phenol and packed.

Lewis reported the following clear case :—

Case 17.—A patient complained of a swelling under the tongue and also beneath the left jaw. He had been operated upon four times inside the mouth, and each time the cyst recurred. In 1919 he had a cyst the size of a goose's egg beneath the jaw. He refused a general anæsthetic, and a local anæsthetic was injected. The cyst ruptured, but as much as possible was removed, together with the sublingual and submaxillary glands. A year later there was a recurrence in the neck. This time a general anæsthetic was used and the cyst wall dissected out intact, and easily traced to the point in the mylohyoid muscle where it emerged. The muscle was slit and the whole cyst removed.

The writer states that the cyst originated in the sublingual or Fleischmann's bursa, but, as is usual, no evidence is produced why it should originate in this supposed bursa.

Boyer reported a good case illustrating the next stage of extension, which has the additional interest that the patient in her youth was operated upon by Baron Larrey, Napoleon's famous Marshal, who, he said, was worth battalions to his army :—

Case 18.—A woman, age 40, had had a congenital ranula which had been opened many times and fluid like white of egg let out. Fifteen years previously it was of considerable size, projected under the tongue, and made a salient under the chin the size of an egg. Baron Larrey operated upon it with a cautery. This operation appeared at first satisfactory, but later the tumour recurred and increased in size. Further operation was refused. She subsequently became ill with pneumonia, during which illness the tumour increased very much in size. There now existed a tumour in the form of a calabash, the upper and smaller half in the mouth nearly filling its cavity and rolling the tongue backwards against the palate. The other half was below the chin, the size of two fists, and descended vertically in front of the neck. There was a deep groove between the posterior margin of the tumour and the front of the larynx. It swelled out below the level of the jaws and drew strongly on the skin of the chin and the cheeks, rendering it excessively tense. The surface of the tumour was red, tender, hard, and inflamed, and the patient could scarcely open her mouth. The face was cyanotic, and swallowing and speaking were difficult; there was fever. The tumour was punctured twice, and a flocculus of pus squirted out about a yard by its own pressure. A seton was passed, and half a litre of pus came away. The tongue returned to its place and the symptoms were relieved. After washing out the cavity for some days, only fistulous openings remained.

These cases sometimes gave rise to alarming symptoms, which are illustrated in the case reported by Wheeler:—

Case 19.—The patient suffered from a large ranula complicated by a tumour beneath the jaw. The usual signs of ranula were present, better marked than in the generality of cases. The tumour beneath the jaw was the size of a Seville (bitter) orange. She had known of the ranula for about a year, but was unaware when the tumour appeared beneath the jaw. The two tumours were thought to be distinct from one another. The appearance of the latter tumour gave one the impression that there was a calculus in Wharton's duct. A piece of the cyst beneath the tongue was excised, and glairy fluid came out, and later some dark fluid. Pressure beneath the jaw caused a further flow and emptied the tumour. Notwithstanding that a 'large piece of bone' was removed from the ranula, the swellings reappeared.

One day she was in her usual health, but by the evening she was suffering intense dyspnœa, her eyes were starting from her head, the countenance was anxious and distressed, and she was in a cold perspiration, sitting up grasping the bedclothes like one with asthma. Both tumours had increased greatly. An incision was made into the dorsum of the tongue on each side near the raphé. As not much relief was obtained, incisions were made into the two swellings, and fluid escaped from both and relief followed. The epiglottis could now be felt, and as it was swollen it was scored with a knife. Poultices and fomentations were applied and the patient managed to swallow half a teaspoonful of milk. Next day the tumour beneath the jaw was opened and its cheesy contents were removed. Complete healing followed.

In this case, if the 'piece of bone' removed was really a calculus as it had been suspected, then it merely proves that an ordinary obstructive ranula may form a large cyst beneath the jaw. The 'cheesy' consistence of the contents might mean that this case should not be included here but was really a dermoid. In Malcolmson's case, however, the contents were not only cheesy but solid in parts, though derived from the submaxillary gland. Tay also removed five masses like hard butter from a ranula, and Leclerc let out glairy fluid and sandy material.

The recovery was probably due to the inflammation, which cured many such cases and also brought about a cure in the astonishing instance related below. This was reported by Paget, and will carry the conviction which is borne by all that great observer's writings. It illustrates the extension taking place in an upward direction into the face:—

Case 20.—A man, age 34, had a cyst over the right side of the face and neck. It was half filled with fluid, irregular, lobulated, subcutaneous, and extended from the level of the cricoid up over the jaw to the malar bone and the zygoma, back to the masseter muscle and the posterior border of the lower jaw, and as far forwards as the middle line beneath the chin, and to the angle of the mouth. It was described as being "soft, flaccid, fluctuating, and flapping". On pressure "a little glairy, fluid oozed through a small aperture in the middle line in front of the frænum lingue". The floor of the mouth was slightly raised and harder than normal. This swelling had existed for four years. It had commenced as a swelling under the tongue, which after a year burst, discharged glairy fluid, and disappeared. There was no further swelling under the tongue. Next there appeared a swelling under the jaw, and this burst as before under the tongue and disappeared. This swelling appeared again under the jaw and gradually spread out on to the cheek, without pain. It was punctured, and twelve ounces of glairy fluid were drawn off, tinged with pink. It was punctured again later, and then suppurated, and so was cured in two months' time.

In this case there can be no question but that the tumour began under the tongue and eventually extended to the limits indicated. Other cases are mentioned by Després, Bellonard, and Dieu. The climax, however, is reached in the case reported by Malcolmson :—

Case 21.—A sickly Hindoo boy of 9 came on account of a swelling which extended from one ear to the other, up over the angles of the jaw, up on to the cheeks, and down to the sternum, over the upper end of which bone it was pendulous and could be lifted up. It was quite soft and contained fluid. The disease had started a year previously. Before the tumour was noticed, a discharge of pus had been seen half an inch to one side of the opening of the left submaxillary duct. There was a depressed cicatrix at this point, and the swelling was said to have started here. A slight discharge could still be seen from the duct. From these facts it was thought that the duct had inflamed in consequence of septic teeth, and the saliva had found its way out into the connective tissues and formed the great swelling described above. A puncture was made into the swelling, and twenty ounces of glairy fluid, transparent and of a light-brown hue, were withdrawn. A hard mobile substance was then felt and was extracted on enlarging the opening. It proved to be part of the fluid which had become inspissated. The opening was

left and the discharge pressed out every morning. The puncture then closed and another had to be made. After this the skin of the cheeks seemed to unite with the underlying muscles from which it had been separated, so that in this area healing was obtained.

The patient was then lost sight of for some weeks and the puncture closed. He was seen again, and another puncture was made and much fluid drawn off; suppuration took place and pus followed for some time. A probe passed into the mouth of the duct caused saliva to flow. A portion of the skin of the tumour was removed and the tissues were laid bare; it was as if a dissection was made of the neck; everything from the ears to the sternum was exposed, with the blue veins and parotid glands showing through. A search was then made for the origin of the

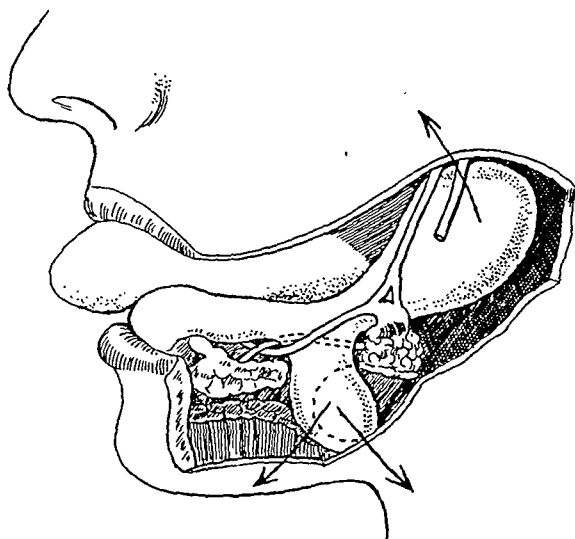


FIG. 299.—*Case 22.* The diagram shows a ranula under the tongue. The arrows indicate its extension through the mylohyoid muscle to below the chin, to the neck and face, and to the fauces.

fluid, and it was traced to a soft round body like a small lymphatic gland which proved to be part of the submaxillary gland, pressure upon which caused the glairy fluid to exude. The submaxillary gland was removed, and the cautery applied to the stump. The wound healed up at once, and nothing more was discharged into the mouth.

The next case (*Fig. 299*) is an illustration of extension which sometimes may take place inside the mouth into the fauces and pharynx :—

Case 22.—A woman of 34, who had a left-sided ranula under the tongue which was repeatedly opened and fluid like the white of an egg let out. Digital examination showed that there was an extension backwards under the mucous membrane

into the parafauical region as well as an extension into the submaxillary region. She also had a typical sublingual ranula on the right side, which was quite distinct and which was removed, the opposite side being left severely alone. (Blair.)

CONCLUSIONS.

From a consideration of such cases, which fairly represent every form of tumour described, we can only come to the conclusion already laid down that these tumours form first in the mouth, and then spread, extend, or burrow into the other regions. Many are in connection with the submaxillary gland, others are not so obviously in connection with this gland, and others again have no connection with it. When traced to the region of the sublingual gland we have no means of telling whether they are mucous or salivary in origin. Birkett mentions one in which a probe could be passed along Wharton's duct, though there was a ranula with an extension into the neck.

Fleischmann described his bursa in 1841. but no one has been able to confirm his findings. The efforts of Tilleaux to establish the bursa were not accepted by his hearers. Skillern reported a bilocular ranula which he said originated in the bursa, but no proofs were forthcoming. The white-of-egg fluid was different perhaps from saliva, but it was not analysed, and seems to have differed very little from the fluid found in those cases which were obviously in connection with the submaxillary gland. I am not aware if the fluid from any of these extensive cases has been analysed, or if it differs, as well it might, from normal saliva. We know that saliva from the submaxillary gland differs from that of the parotid, and in physiological text-books it is said that saliva from the sublingual is intermediate between the two; but I am unaware that it has ever been collected in man. Skillern says that Leopold Gmelin proved that the fluid from a ranula has no similarity to saliva, but the reference he gives is wrong (Wochlors u. Liebigs *Annalen der Chemie u. Pharmacie*, lxxiv, 95). (The only reference to this writer I can find is in the volume published in 1835, i, 95, which refers to the analysis of a 'lung stone'.)

Lewis, seeing Skillern's case, reported a similar one, and attributed it also to this bursa, but neither does he give reasons for so doing. Careful search by anatomists has always failed to find this bursa. Artificial spaces are easily made in the loose tissues between the geniohyoglossus muscles, and to this fact we must attribute the description of the bursa. Another theory as to their origin has been put forward by Thompson: that these ranulæ start from the cervical sinus left by the development of the branchial clefts. "Wharton's duct and the sublingual gland can be seen superficial to the cyst, but not structurally connected with it"; and again: "I have satisfied myself in every case of ranula that has come under my observation that neither Wharton's duct nor the sublingual gland are responsible by finding that these structures were healthy and normally placed".

I might accept the reference to the submaxillary gland if it had not already been proved that the submaxillary gland has been in direct communication with these extensions, as in Malcolmson's case; but with regard to the sublingual gland this statement cannot be allowed to pass. It is difficult if not impossible to make out the sublingual gland in connection with a ranula,

and it is because of this uncertainty that our ideas upon the subject are so untrustworthy. Secondly, how can one prove that the sublingual glands are healthy or normal? Can anyone pass a bristle into them? I have never been able to do so. Does anyone know how many ducts are present in each gland? According to Suzanne's dissections the ducts differ remarkably in number and pattern. If one is blocked, how are we to know, for now we cannot pass in even the bristle, and therefore we cannot know that a duct should be there? I cannot help thinking that Thompson has eliminated the sublingual gland because it is in the way of his theory. He owns the possibility of the mucous glands. But why not then accept Fleischmann's bursa as the remnant of the cervical sinus? Well, that is perhaps obvious—no one can find it. There is one insuperable obstacle against accepting the theory of the cervical sinus, and that is the lack of an epithelial lining to the cyst walls. No one has described any epithelial lining with the sole exception of Lewis, and he attributes the swelling to Fleischmann's bursa, in which there should be no epithelial lining. One wonders therefore if Lewis did not really mean endothelial and not epithelial lining. The lining of the swelling in the mouth is always mucous membrane or glandular when examined; once the swelling has burst and gained the connective tissue, the lining will be endothelial. It is just this lack of any epithelial lining which makes these cysts so easily cured once they suppurate or become inflamed.

Thompson also says: "I have made a somewhat exhaustive search of reported cases, but so far I have been unable to find cases that correspond anatomically to these reported above", referring to the two he published. His cases were of the ordinary bilocular type already quoted, with not very large extensions into the neck. No exhaustive study of the cases has been made in this paper, but from those cases included, which are only a selection, one can gather that they are not as rare as he supposes. I might suggest also that some of the rare cysts which have been described in the neck may be related to this condition. It is not from the study of two examples that a true picture can be drawn: the whole range of cases must be considered, and it is for this reason that this paper has been unduly laden with case reports.

The conclusions drawn are that a ranula may arise in the salivary glands, including Blandin's gland, and in the mucous glands, and nowhere else. There is nothing to favour the view that Fleischmann's bursa exists, and there is nothing to connect a ranula with the supposed survival of a cervical sinus.

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SOME CONTRIBUTIONS TO THE RECONSTRUCTIVE SURGERY OF THE HIP.

By ERNEST W. HEY GROVES, BRISTOL.

*(Being the Bradshaw Lecture delivered before the Royal College of Surgeons, England, on
November 11, 1926.)*

Of all the joints in the body the hip is perhaps the most important, and in regard to its ailments is certainly the most difficult for treatment.

Whilst our remote ancestors were quadrupeds who bore the body weight on four limbs, our nearer progenitors were tree-climbers or jungle-dwellers and still used the forelimbs almost as much as the hind for progression. The human being now has to do all his weight-carrying on two limbs only, except during a brief period of infancy, when he begins his life with his ancestral crawl. This evolution from quadruped to anthropoid and anthropoid to human mode of progression has involved a big strain on the hip, for it has to carry double the weight and also provide for a balancing of the erect body. It is the only joint which is commonly affected by congenital dislocation, and its liability to spontaneous or pathological dislocation is far greater than that of any other joint. The two most important diseases of joints—namely, tubercle and osteo-arthritis—attack the hip more frequently than any other single joint, and the result of such attack is more serious and more difficult of treatment.

Anatomically, too, the hip presents important characters of its own. The large epiphysis of the head is entirely intra-articular and possesses a very poor blood-supply apart from the vessels which enter it from the diaphysis. The angle which the neck of the femur makes with the shaft, perfectly adapted for conditions of health, is very liable to distortion by disease or trauma, and this distortion at once destroys the correct balance of the trunk on the lower limb.

To replace and retain the dislocated hip; to re-establish correct relations between an ill-formed femoral head and an ill-developed acetabulum, and to attach a displaced epiphysis or to mend the broken neck of the femur, keeping it at the correct angle with the shaft of the bone; to remake the joint when it has been destroyed by inflammation; and to replace by active structures the paralysed muscles required for balancing the body in the erect position—these are the problems which constitute the reconstructive surgery of the hip.

Considerations of time and space prevent me from dealing either with the history or the literature of this subject, and I propose therefore to confine myself almost entirely to my personal experiences.

FRACTURE OF THE NECK OF THE FEMUR.

The true neck of the femur lies proximal to the intertrochanteric line, and it is only about the fractures of this region that we are concerned. This is the intracapsular fracture of the older writers, but it is better described

to-day under the terms subcapital or basal, according to whether the line of fracture is near to the head or the base of the neck. The extracapsular or pertrochanteric fracture involves the trochanters, and in its mode of healing and reaction to treatment exactly resembles fractures of the other parts of the diaphysis—that is, it forms abundant callus and undergoes rapid and firm union which is very liable to deformity unless efficiently treated by traction and splints.

Causes of Non-union.—Fracture of the true neck of the femur is notable for the fact that it never unites naturally—that is, if the patient merely lies in bed with the leg in line with the body. This tendency to non-union used to be attributed to old age, but this certainly is not correct, because the fracture unites quite well in old people if properly treated, and is just as obstinate with regard to non-union in a young man as in an old one if special treatment is not adopted. I would place the causes of non-union in the following order of importance: (1) Defective blood-supply; (2) Defective apposition of the fragments; (3) Interposition of the capsule; and (4) The inhibitive influence of the synovial fluid.

About the fact and the effect of the defective blood-supply there can be no doubt. The head of the bone gets a very feeble and inconstant supply through the round ligament, and its main nutriment through the vessels which run up the neck, which latter are all torn by the injury. It is untrue to say



FIG. 300.—Fracture of the neck of the femur, twenty-five years after the causal accident.

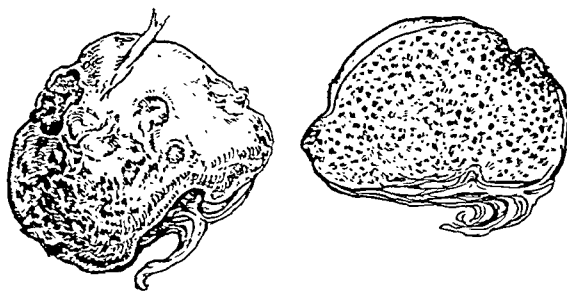


FIG. 301.—The same case as Fig. 300. Head of the femur shown after removal; the structure proves that vitality has been retained.

that the separated head is dead, because—whether by the vessels of the ligamentum teres or by the synovial nourishment of the cartilage—the fragment certainly retains living cells and is capable of resuming active life for a long time (Figs. 300, 301). It would be fair to say that the head of the femur so long as it is separated from the

shaft is in a condition of suspended animation. However quickly or efficiently the fracture is treated, there is never any callus excess; in fact, it would be difficult to demonstrate callus formation in any case at all. It is a region where neither periosteum nor endosteum exists, so bone granulation tissue or

callus cannot be expected. This means that there is no provision for filling up interstices or bridging gaps such as exists in those fractures of the shaft where apposition is not perfect. On the other hand, if the fragments are firmly and accurately apposed, bony union will take place with certainty. This explains the most characteristic feature of these fractures—that is to say, that they will never unite unless perfect apposition of the broken surfaces is secured; but if this is done, firm bony union occurs. Another evidence of the influence of defective blood-supply is seen in the rapid atrophy of the proximal fragment which occurs if correct treatment is delayed. Within three to six months of the injury all that part of the neck of the femur which is attached to the head disappears. This is a point of great practical importance because it means that if efficient treatment is delayed perfect reconstruction of the neck can never take place.

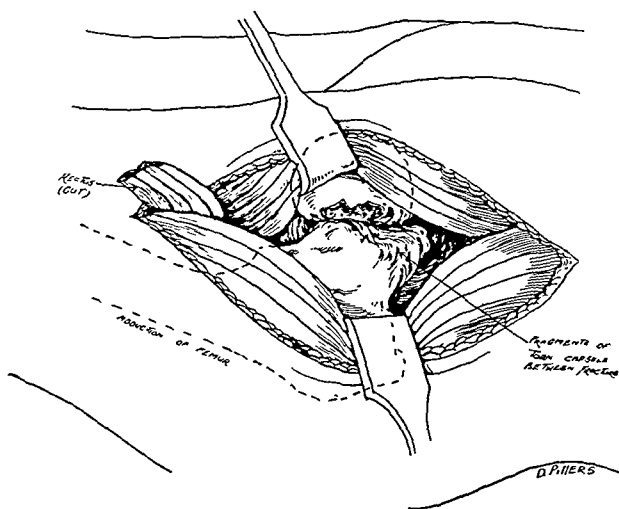


FIG. 302.—Drawing of exposure of a fractured neck of the femur. The reflection of the torn capsule over the distal fragment is well seen.

These, then, are the main causes of non-union—namely, defective blood-supply and a want of apposition—but the other two causes mentioned above have to be considered. In many cases the reflected portion of the capsule of the joint hangs over the torn end, usually of the distal fragment, and thus interposes a fascial membrane between the broken bone surfaces (Fig. 302). This interposition may not be so complete as to prevent union if by manipulation the bone surfaces are impacted one against the other, but it must tend to delay union, and sometimes actually prevents bony union.

The effect of the synovial fluid which bathes the broken surfaces of the fracture is more problematical than that of the factors already mentioned, but it cannot be ignored. The effect of the synovia is to deposit a fibrous surface on the raw bone and so to seal up its cellular elements. Thus, after a few weeks both surfaces will be covered with this fibrous tissue which will make the bony union more difficult even if by manipulation the bone is impacted. There is, then, a quite adequate explanation of why these fractures will not unite if left to nature. Immediately after the accident the broken surfaces fall apart, the distal fragment being pulled upwards by the contraction of the muscles and falling outwards by the weight of the leg producing external rotation. There is no capacity for callus production to bridge the gap, whilst the torn reflected fibres of the capsule hang over the broken surface of the distal fragment. In a few weeks both broken surfaces become covered with fibrous tissue, and in a few months the proximal fragment has greatly atrophied.

Treatment of Recent Fractures.—These considerations at once give the three essential points in treatment—namely, early intervention, accurate apposition, and firm fixation. Whilst these principles are universally accepted by all specialists and by the majority of surgeons, yet, unfortunately, they are not acted upon by a great many in general practice. The very existence of the fracture is often overlooked, owing to the fact that the injury is usually one resulting from comparatively trivial violence such as falling on the pavement. Then, when after several weeks the X rays are applied and the fracture is seen, there is a tendency either to minimize its severity and to temporize with bed and sandbags or a Liston's long splint, or, on the other hand, to regard the fracture as unamenable to treatment and to let the patient get up with crutches as soon as he likes. It is only perhaps after six months or more that the pain or the lameness calls for another opinion, and then the time has gone by when a perfect cure can be effected.

ABDUCTION IN PLASTER.—Although the fracture presents such varied obstacles to natural union, it is not difficult to obtain apposition of the bone surfaces by manipulation. Under an anæsthetic traction is made upon the leg until it is the same length as its fellow, and then, without releasing the traction, the limb is first inverted and then brought up into extreme abduction with a little flexion. This manœuvre can be done under the observation of the X rays or when the parts are exposed by an open operation, and it will be observed how the internal rotation and abduction do force the broken surfaces of the neck together. But two further points are noticed: (1) That the proximal fragment may remain out of place, usually looking forwards or upwards, and that no movement of the limb can correct this; and (2) That frequently a part of the capsule of the joint lies like a veil over the distal fracture surface. When the triple manipulation of traction, internal rotation, and abduction has been accomplished, the limb is fixed with plaster-of-Paris extending from the lower part of the chest to the toes, and so it remains for about three to six months with one or more changes of plaster case.

Whitman, who has fully established the efficiency of this method both in theory and practice, seems to think it should be the routine procedure for all cases. His advocacy has been sufficient to convince most surgeons, and it may be said that to-day abduction followed by plaster is the standard mode of treatment. Although this method is a very great advance over either traction or simple splinting, and has proved that even in old people fractures of the neck can be made to heal by bony union, yet in my opinion it is by no means ideal or convenient. In the first place it is liable to failure, and this failure is recognized only after the long tedium of confinement in a plaster case has been endured. That failure does occur frequently is shown, for example, by such figures as those of Waldenström,¹ who in 43 cases reports failure to produce bony union in 22. The explanation of the failure lies in the two facts already mentioned—namely, that the upper fragment cannot be controlled and often lies with its broken surface pointing forwards, and that part of the capsule interposes between the broken surfaces. The method is not easy to carry out unless hospital accommodation allows the patient to be kept in for three to six months. Even then the retention of the abdomen and leg in plaster for such a long period is open to the objection that thin

patients may be rubbed sore, or that fat patients cannot be efficiently fixed. Moreover, even if all these difficulties are surmounted, the method still imposes a great strain on patient and nurse.

THE PEGGING OPERATION.—As far as I am aware, no one surgeon is especially to be credited with the idea of fixing the broken femoral neck by means of a bone or ivory peg. The method was gradually evolved from that of using a long carpenter's screw. This screw, which is still used by many surgeons, is open to the objection that it gets no good hold in the soft cancellous tissue of the neck and head of the bone, and it does not become incorporated in the skeletal structures. The substitution of a peg for a screw was suggested by the better mechanical hold given to the former, and by the idea that a bone-peg would become a part of the new bone. There still remain differences of opinion whether the peg should be made of a living graft taken from the patient's own skeleton or of a piece of animal bone or ivory; also whether it should be driven in blindly or under the guidance of an open operation.

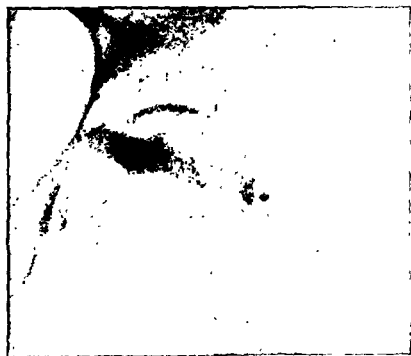


FIG. 303.—Peg driven too far.

I propose to describe the operation as I think it should be done in most cases, and will then refer to possible modifications in respect to these details.

A bone peg is provided about $4\frac{1}{2}$ in. long and $\frac{3}{8}$ in. thick, pointed at one end and square in section. A metal handle to the peg is convenient, though not necessary, for driving it into place. A very accurate estimate should be made from the X-ray plate as to the exact length to which the peg has to be driven into the bone, and this length should be marked by providing a collar or head to the peg which will rest against the outer surface of the femur when the peg has been driven in to the correct extent. If this detail is not attended to, there is a liability for the peg to be driven in too far (*Fig. 303*) and so enter the joint, or else for it not to be driven in far enough and so not attain its maximum efficiency (*Fig. 304*). Both these errors have happened in my practice, and though they have not resulted in any serious consequences, it is clearly better to avoid them.



FIG. 304.—Peg not driven far enough.

The patient lies on the table with the affected hip over the edge. The joint is exposed by an anterior incision about 6 to 8 in. long, the centre of which is at the anterior superior iliac spine, the upper half of the incision running along the crest of the ilium and the lower half along the line of the sartorius. The incision is deepened, the fascia divided, and the muscles are

separated from the crest and outer surfaces of the ilium, the tensor fasciæ femoris being separated from the sartorius. By this means the anterior inferior spine is exposed with the origin of the rectus femoris muscle. The latter is divided and the front and outer surfaces of the hip-joint are exposed. The capsule is divided by an incision parallel to the direction of the neck of the femur, and this lays bare the fractured surfaces (*Fig. 302*). Torn and reflected parts of the capsule which lie over the distal fragment are retracted; the head of the bone is difficult to control because only so small a part of the neck is exposed, but it can be rotated into correct position and there held by stabbing a drill into it right through the edge of the cotyloid ligament.

The outer surface of the great trochanter is now approached either by turning the original skin-flap outwards or by making a vertical incision outwards from the middle of the first incision. This enables one to expose the outer

surface of the great trochanter covered by the upper fibres of the vastus externus, and is much more satisfactory than getting at the point for insertion

of the peg through a separate stab incision. The depression just below the great trochanter is identified, and a hole made up into the neck with twist-drills, beginning with $\frac{1}{4}$ in. and increasing up to a drill of the same diameter as the peg to be used. The point of the drill is in the first place made to emerge at the centre of the femoral neck, the leg being externally rotated so as to throw the broken surface forward. Then the leg is so manipulated by traction, abduction, and internal rotation as to bring about as perfect restitution as possible, the head being in the meantime fixed by the transfixing awl. The drills are then made to penetrate the head of the bone to the correct depth so that a path for the peg is prepared. The square peg is driven into the round hole, into which it fits very tightly (*Figs. 305-308*). It is

FIG. 305.—Fractured neck of the femur in a man of 35.



FIG. 306.—The same case as *Fig. 305*. The man returned to work four months after the accident.

most important to see that it goes in far enough, but not too far. The part of the peg which projects is cut away. The capsule is carefully sewn together

and then a few points of suture serve to re-attach the divided muscles, and the skin is joined by clips.

After the operation the limb is slung to an overhead beam or on a cradle splint so that the knee and hip are semiflexed and the whole leg is kept in moderate abduction. A weight traction of about 10 lb. serves to steady the limb. After ten days when the wound is healed and the stitches are out the pelvis and thigh may be encased in a light plaster spica, or else the position of flexion and abduction may be maintained by weight traction, the leg being slung. I would only use the plaster for cases that have to be moved to a distance; if the patient can be kept under the observation of the surgeon and the care of a competent nurse, plaster fixation is quite unnecessary. At the end of four to six weeks the patient is allowed to walk with crutches and a caliper splint. In three to six months' time he walks without any splint at all.



FIG. 307.—Fractured neck of femur in a woman of 60.

The Slipped Epiphysis.—The displacement of the epiphysis of the head of the femur is a very remarkable injury both in its origin and its results. It is brought about by comparatively trifling violence, and the accident which produces it is often hardly remembered. The patient is not aware of any serious disability at the time, but becomes progressively lammer. If the case is seen at an early stage—that is, within a few weeks of its occurrence—the reduction by manipulation can be effected. Arguing on the same lines as above, I would say that this reduction had much better be done under the guidance of an open operation, and, when done, fixed by a bone nail (Figs. 309, 310). When the injury is only recognized at a later date, after union in a faulty position has occurred, it will be necessary to cut through this faulty union and perhaps remould the neck of the bone before nailing it together. It is certainly much better to do this than to wait for the establishment of a coxa vara (Fig. 311).

MODIFICATIONS IN THE PEGGING OPERATION.—

1. *Peg Inserted from Above.*—When the fracture is very close to the anatomical neck of the femur it is difficult to expose the upper fragment or to see exactly how it lies, and it needs great accuracy to put the peg exactly to the correct



FIG. 308.—The same case as Fig. 307 after pegging: perfect recovery.

depth. In such cases it is better to nail the head on to the shaft, instead of nailing the shaft to the head. When the joint has been opened the cotyloid ligament is cut through and two angular flaps of capsule are formed

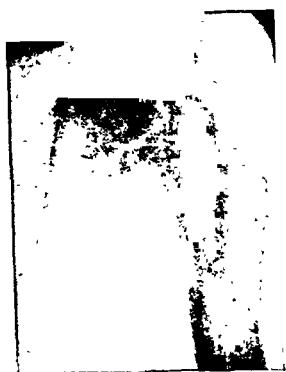


FIG. 309.—Hip from boy of 18, showing a slipped epiphysis.



FIG. 310.—The same case as Fig. 309 seven months after pegging, showing the almost complete absorption of the peg.

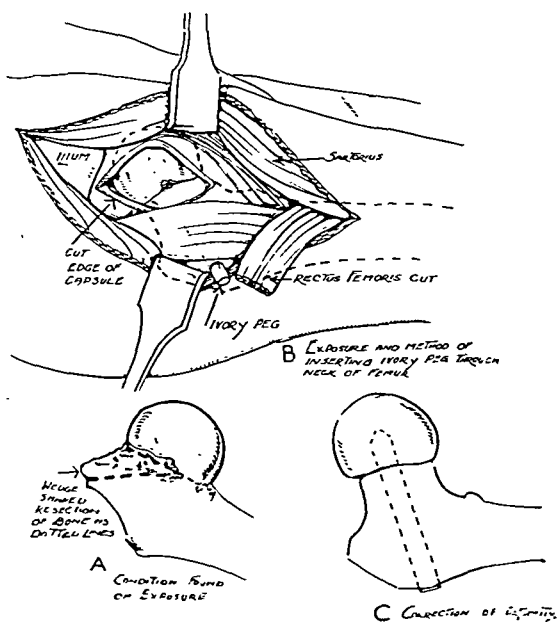


FIG. 311.—Hip of a girl of 12, eight weeks after the epiphysis had slipped. A, Resulting deformity; B, The operation; C, Head and neck after reconstruction.

by the addition of a cross cut through the capsule at the edge of the bony lip of the acetabulum (Fig. 312). These flaps of capsule are held aside by strong tissue forceps, and then by means of a curved retractor the head is dislocated without division of the round ligament. This allows of a

perfect adjustment of the head to the neck, and, after drilling, the former is fixed to the latter by a bone nail 3 in. long and $\frac{3}{8}$ in. thick, having a very small flange at the head. This modification of the operation is particularly

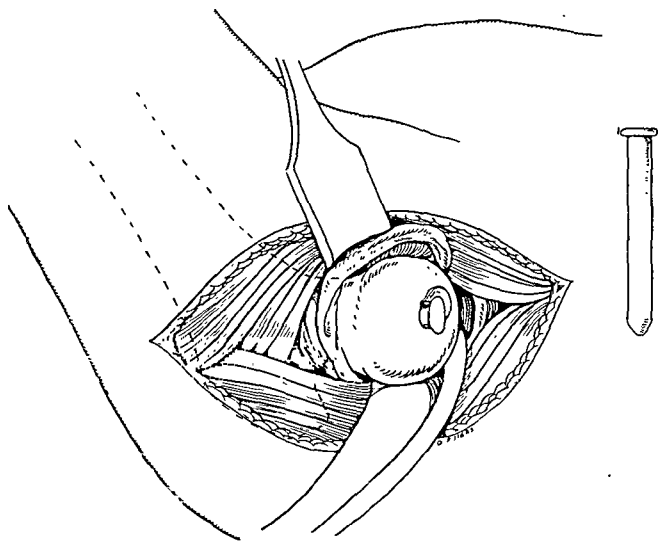


FIG. 312.—Fractured neck of the femur in a woman of 65 with very short proximal fragment. Diagram of the operation, showing the peg being inserted from above.

indicated in old-standing cases when the proximal fragment is small and the neck atrophied. It gives a greatly increased mechanical efficiency in holding the head in place (*Figs. 313, 314*).



FIG. 313.—Skiagram of the same case as Fig. 312 before operation.



FIG. 314.—The same case as Fig. 313 six weeks after operation.

2. *The Use of an Autogenous Peg.*—In my earlier cases I always used an autogenous peg cut from the crest of the tibia; but in recent fractures just as firm and rapid union has been achieved by the use of a dead-bone nail, and there are two distinct advantages in the use of the latter: (*a*) The operation is simplified and shortened; and (*b*) The peg can be prepared beforehand with greater precision than can be applied in the use of a peg cut at the time. I

have had one case, too, where a fracture occurred in the tibia after the patient began to walk, and though this healed quickly, yet it was rather a tragedy. It is possible that the use of a part of the shaft of the fibula as a peg is better than that of a graft taken from the tibial crest, but I think it is an unnecessary complication in most instances, and it should be reserved for old cases of non-union where the difference between a living- and dead-bone peg may justify the extra operation. Henderson² has used this method, and his cases show excellent results.

3. *The Blind Insertion of a Peg.*—There are certain obvious advantages in the insertion of a peg through a small external incision without exposing the joint. It is an easy and a simple operation, but it is liable to grave drawbacks. In the first place it is very difficult to make certain that the peg is going exactly in the right direction; Fig. 315, for example, shows a case where the peg has altogether missed the neck of the bone. In the second place it does not give opportunity of exact reposition of the fracture, especially in regard to correct orientation of the head; neither does it allow the removal of the interposing flap of the torn capsule. With certain precautions, however, it may still be a useful modification of the operation in some cases. The correct direction and depth of the peg can be assured to some extent by the observation of the bony landmarks of the pelvis, and by a preliminary measurement of the bone and preparation of the peg with an outstanding head or collar which should be a guide to the correct depth. The leg is pulled down, abducted, and inverted. When the depression below the outer surface of the trochanter has been identified through an external incision, the drill is inserted so as to point to the anterior superior iliac spine of the opposite side. But in addition to these precautions, I think that the operation should be done under the guidance of the fluorescent screen. I would reserve this modified operation for the cases in which age or debility makes it unwise to carry out a more extensive procedure.



FIG. 315.—Peg inserted 'blindly'. It has missed the neck of the femur. Case seen for the first time one year after operation.

In my own experience the results of the pegging operation have been so uniformly good that I should regard it as one of the most satisfactory operations in bone surgery. If it is done early, before atrophic changes have occurred, bony union is assured and the patient will regain full functional recovery within six months of the injury.

Slowness of union and length of the period of recovery will be in proportion to the delay that has occurred between the accident and the operation. It is very important to lay stress on this point, because if my view is correct, then the operation ought to be carried out as soon after the injury as possible and not left as a last resort for those cases in which plaster abduction has failed.

The Treatment of Long-standing Non-union.—This is a very much more difficult problem. The cases may be divided into three categories: (1) Those in which delay in efficient treatment or failure of treatment has caused non-union, without much atrophy or displacement. (2) Those in which the neck of the femur has been absorbed, without much displacement. (3) Those with absorption of the neck and great upward displacement of the femoral shaft.

1. In the first group I think that the pegging operation should certainly be done. The only modification of detail necessary will be thorough exposure of the fractured surfaces with removal of old fibrous tissue, and the use of a portion of the shaft of the fibula as the peg, in order to increase the sources from which new bone may be derived. This can be relied upon to bring about firm union and a useful limb which the patient can use without pain. I have sometimes found, however, that though union is firm and painless, yet there is great limitation of movement in the hip-joint. This is probably due to the fact that the nutrition of the head of the bone has been impaired and its cartilage lost, so that it eventually becomes fixed in its socket.

2. In the second group, where the neck of the bone has been absorbed, the choice of procedure will lie between removal of the head altogether and a

fixation of the head to the shaft, but in either case the upper end of the femur will have to be reconstructed so as to ensure a bearing between the femur and the acetabulum. The necessity or advisability for any operation will be determined by the amount of pain which the patient suffers. If this is so great that it makes him bedridden or dependent on crutches or a caliper splint, then it is certainly worth while to do

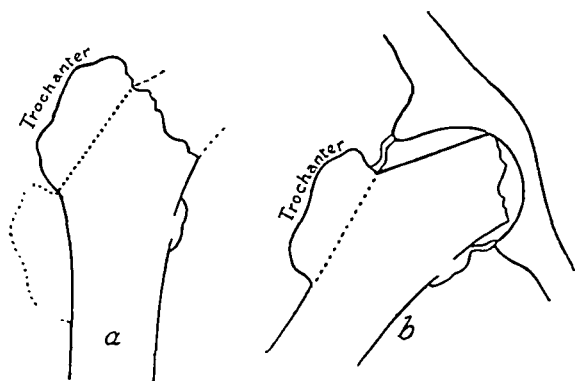


FIG. 316.—Diagram of Whitman's operation.

something, for, though the operation may leave him with a weak or lame leg, it will undoubtedly relieve him from pain. The simplest procedure is certainly that devised and advocated by Whitman (*Fig. 316*). It consists in first removing the head of the bone and then cutting off the great trochanter so as to allow the stump of the neck of the femur to engage in the acetabulum. The trochanter is then attached to the shaft of the femur at a lower level. This operation will only succeed if there is sufficient neck left to form a new head in the acetabulum. If the neck has quite gone, it is difficult to prevent the shaft of the femur from riding up on to the dorsum ilii as soon as abduction is discontinued. To overcome this difficulty I have utilized the head of the bone in order to make an exaggerated rim to the acetabulum (*Fig. 317*). The head of the bone, having been removed, is cut into two parts and these are shaped so as to make a curved mass of the approximate shape of the hip socket. The upper margin of the acetabulum is then bared and a raw surface of fresh bone prepared. To this the pieces

of femoral head are fixed by nails. The trochanter is transplanted to the outer surface of the shaft, and the raw surface at the top of the femur

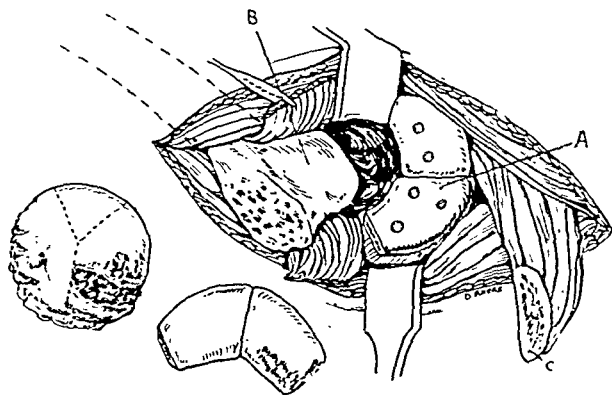


FIG. 317.—New rim made to acetabulum from the head of the femur. A, Portions of the head nailed to the edge of the hip socket; B, Neck of the femur after removal of the head; C, Great trochanter sawn off. The small figures show the head of the femur and the methods of cutting to shape.

which is to rest against the reconstructed acetabulum is covered by sewing over it the capsule of the joint (Figs. 318, 319). Wherever it is possible,



FIG. 318.—The same case as Fig. 317 before operation.



FIG. 319.—The same case after reconstruction operation.

however, I think it is better to retain the head of the femur for its natural purpose, attaching it to the shaft of the femur by an autogenous peg, driven in from above downwards in the way described.

Albee³ has made what seems a very useful suggestion—namely, to shift the trochanter outwards without quite detaching it from the shaft (*Fig. 320*).

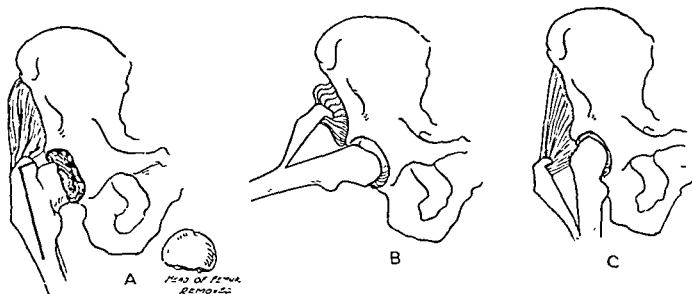


FIG. 320.—Diagram of Albee's operation. A. Shows line of division of the femur after removal of the head; B. Trochanter separated, leg abducted; C. Leg brought down, trochanter forming an outstanding piece of bone.

He does this by a longitudinal cut down the point of junction between the trochanter and the shaft, breaking the trochanter outwards by a partial fracture held in position by the periosteum and soft parts. The limb is put up in abduction, and when consolidation has occurred the trochanter will be an outstanding piece of bone which will give the abductor muscles attached to it considerable mechanical advantage.

3. In the third group of cases the femoral shaft has become displaced upwards, and the limb is consequently 2 or 3 in. shorter than its fellow, with all the characteristic lameness that is associated with dislocation of the hip. Such cases are fortunately not very common, and their origin is rather obscure. The cases I have seen

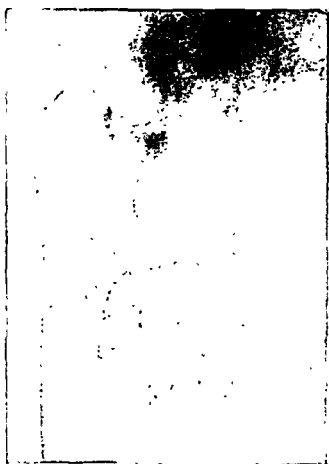


FIG. 321.—Late case of fractured neck of femur before operation.

have been in young men who have had no severe accident, so that the deformity has developed insidiously and has been regarded as congenital dislocation. It is probably an extreme displacement of the epiphysis, overlooked at the time of its occurrence. It is distinguished from dislocation by the fact that a well-shaped head of the femur lies in the acetabulum, which is of normal size.

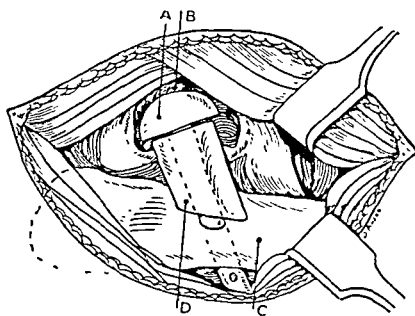


FIG. 322.—Diagram of operation for case seen in *Fig. 321*, showing reconstruction of neck. A. Head of nail; B. Acetabulum; C. Shaft of femur; D. New neck made from the shaft of the opposite femur.

It presents a very difficult problem, and clearly each case will have to be treated on its own merits.

In one case (*Fig. 321*), a man of 41, the following method was used with success. The affected leg was first pulled down by pin and weight traction till it was only 2 in. shorter than the sound side. The femur of the sound leg was shortened by taking $2\frac{1}{2}$ in. from its shaft, the bone being united by an intramedullary peg. The old head of the femur was removed from its socket and a new head formed by an ivory nail, which was made to fix the graft taken from the other femur against the shaft, so forming a new neck (*Fig. 322*). The patient is now, four years after the operation, able to lead an active life, and the two legs being of the same length he is not handicapped by having to wear a high boot (*Fig. 323*). If this operation had to be carried out again, I would modify it by utilizing the head of the femur, fixing it to the shaft by the interposition of the new neck taken from the shaft of the opposite side.



FIG. 323.—The same case as *Fig. 322* one year after operation.

ANKYLOSIS OF THE HIP.

Ankylosis of the hip requires surgical intervention only when it is bilateral or associated with fixation of the knee, or when it is the seat of very severe pain. There are three operations commonly done for this condition: excision of the head of the bone, Murphy's operation of remodelling both articular surfaces with the interposition of a fascial flap, and Jones's operation, in which the neck of the femur is divided and the trochanter sawn off and fixed to the proximal part of the neck. About the second and third of these methods I do not propose to speak at any length. Murphy's operation has always given very disappointing results in my hands, and I have heard the same opinion expressed by others. It is long and severe and is followed by great tenderness, so that movement cannot be borne for several weeks, and then so much fixation has occurred that it seems questionable whether the operation was worth while. Apparently the interposed fascia becomes quickly adherent to both raw bone surfaces and this brings about a fibrous ankylosis from the outset. Jones's operation, on the other hand, gives the greatest assurance of mobility and freedom from pain, but these advantages are gained at the expense of the stability of the joint, and the patient may be dependent on the use of crutches or a splint for walking. Whilst expressing the objections I feel to these two operations, I would at once admit that I know of no other one which gives uniformly satisfactory results—that is to say, which fulfils the three requirements of a good arthroplasty in giving freedom from pain, mobility, and stability.

Excision of the head of the bone usually gives two of these results—namely, freedom from pain, and stability or mobility—but it rarely gives the last two at the same time. I have been very much struck by the fact that every patient with double ankylosis of the hip on whom I have operated, after having one side done, has come back and begged for the procedure to be repeated on the other side, which may be taken as evidence that the patient does feel a real benefit from the operation, which seems to be only partially successful. On the details of the operation it is unnecessary to dwell, except to emphasize the two important points regarding special steps that are to be taken in order to secure both stability and mobility at the same time. To secure mobility and freedom from pain the head of the bone must be removed entirely, cutting through the neck of the femur. Any conservation of the inflamed head will, I think, lead to renewed ankylosis. To prevent adhesion

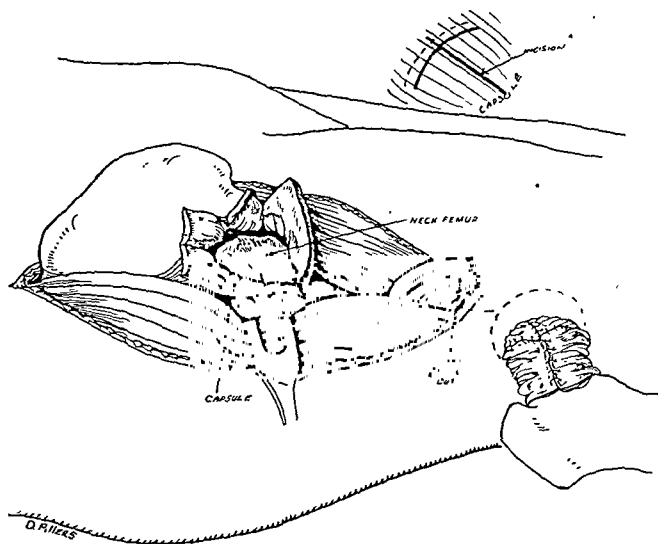


FIG. 324.—Arthroplasty of hip, showing exposure of the neck of the femur by division of the capsule. Inset above, line of capsule division; below, the neck of the femur enveloped in capsule.

of the cut surface of the neck to the rim of the acetabulum, it is better to use the capsule of the joint as an envelope for the end of the femur (Fig. 324). In order to do this the attachment of the capsule to the rim of the acetabulum is cut all round the latter and then sewn tightly over the re-shaped neck of the femur. If the cavity of the acetabulum has any remains of cartilage and fibrous tissue lining it, these are not removed. If the socket presents a raw and rough surface, this is well rubbed with Horsley's wax. If the neck of the femur is so short that it will not engage in the acetabulum when the leg is in line with the body, then greater stability may be given to the joint by fixing portions of the head of the femur on the upper margin of the acetabulum in the way which has been described above (see Fig. 317).

Another method of preventing adhesions and of giving a good form to the head of the femur is to use a large ivory nail to make a new top to the

bone. The inflamed or ankylosed head is removed by sawing through the neck. A hole is drilled downwards and outwards through the centre of the neck into the shaft. The ivory nail, with a square shaft 3 in. long, and a head which forms a half of a $1\frac{1}{2}$ -in. ball, is driven down into the neck and then placed in the hip-joint, where it remains as a new head to the femur (Figs. 325-327).

At the time of preparing this lecture a paper by Baer⁴ on arthroplasty of the hip has come to hand. The essential of his method is the wrapping of the new femoral head in animal membrane—the submucosa of a pig's bladder chromicized so as to resist absorption for twenty days. I may begin by saying that in the number of his cases (100), the length of his experience, and the excellence of his results, he has surpassed anything to which I can lay claim; but it is interesting to note that he regards 25 per cent movement as constituting a good result. I do not dispute his statement that, as compared with ankylosis, 25 per cent without pain or instability is very good; but one cannot help asking, "Why does this limitation of movement occur?" Baer answers this question by saying that "It is due to the stiffness and unstretchableness of the peri-articular tissues". Probably he is right, and I am confirmed in my idea that it is the capsule which is the fixing agent. If, therefore, the capsule is cut all round its pelvic attachment and made into an envelope for the femur, it will be converted from an agent of fixation into one which facilitates movement.

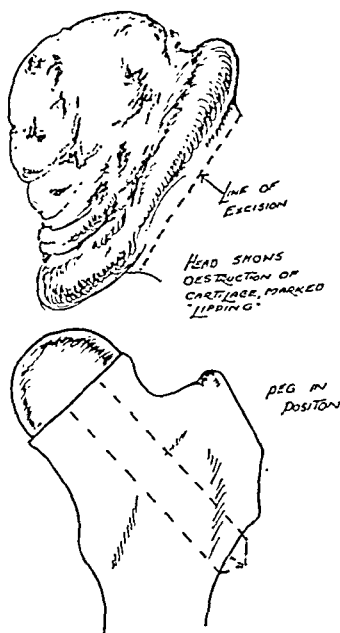


FIG. 325.—Arthroplasty by the use of an ivory nail replacing the head of the femur.



FIGS. 326, 327.—Skiagrams before and after operation, of a case of advanced traumatic osteo-arthritis treated by the method shown in Fig. 325.

CONGENITAL DISLOCATION OF THE HIP.

It is remarkable what a change has occurred in the surgical view as to the possibilities of treatment of this deformity. This change has been due in the first place to the work of Lorenz and other orthopaedic surgeons in showing that the hip could be reduced and remain in its socket, if the case was seen early and treated properly. And more recently the later cases of dislocation have been shown to be amenable to surgical treatment, either by open reconstruction of the joint or by some special form of osteotomy. At the present time it may be claimed fairly that congenital dislocation is certainly amenable to treatment at any stage, although the degree of cure will be dependent upon the age at which the case comes for treatment.

The cases may be divided into three classes according to the period of existence of the deformity: (1) In the first—children up to the age of 3 or 4 years—the dislocation usually can be reduced easily by manipulation. (2) In the second—older children from about 4 to 14 years—reduction by manipulation is either very difficult or impossible, but reduction can still be effected by open operation. (3) The third class consists of adults with extreme displacement of the head of the bone and pain due to osteo-arthritis of the false joint. In these reduction is impossible and relief has to be obtained by osteotomy or arthrodesis. The first fundamental point which requires discussion is the relative advantages of the closed and open methods of reduction. And dependent upon this point is the cognate question as to the choice of method for any individual case.

1. Children from 2 to 4 years.—Those children of about 2 to 4 years in whom manipulation *easily* reduces the dislocation, present such a perfect functional recovery that it is difficult to see how anything better could be

desired (*Figs. 328-332*); but the crux of this proposition is that the reduction must be a simple and an easy matter. I mean by this that, under an anæsthetic, traction followed by flexion, abduction, and rotation should be able to put the head of the femur back into its socket and that it goes back with a click which can be felt or actually heard. In these early cases there is one and only one serious obstacle to reduction, and that is the constriction of the capsule. The head of

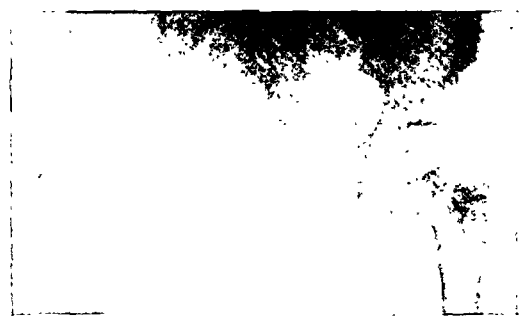


FIG. 328.—Pelvis of a girl of 3, showing congenital dislocation of the right hip.

the femur lies quite close to the acetabulum. It is connected to the latter by a fibrous tube, the capsule, one end of this tube being attached round the margin of the socket and the other round the base of the neck of the femur. After birth, and until the child puts weight on its foot, no marked change takes place, the tubular capsule remaining of about the same length and diameter. Directly walking begins, however, then, the body weight being

FIG. 329.—The same case as *Fig. 328* four years later, showing a perfect result after simple manipulation.

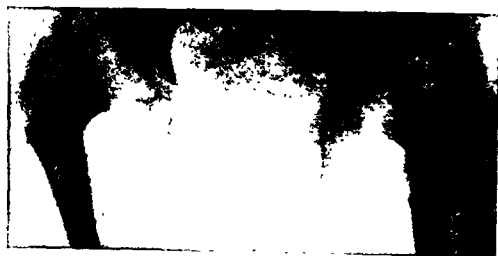


FIG. 330.—Pelvis of a girl of 31, showing double dislocation of the hip, before treatment.

FIG. 331.—The same case as *Fig. 330* after manipulation.



FIG. 332.—The same case as *Fig. 331* six years later, with perfect functional result, but showing very shallow sockets.

transmitted from the pelvis to the femur, chiefly by the capsule, the latter slowly stretches, and, as it consists of an empty tube, the more it stretches the more does its middle part sink in to form the so-called 'hour-glass' constriction. In the course of years, as the body weight transmitted by the capsule increases, the tubular ligament becomes thicker and its central constriction narrower, so that at the age of 6 years, when the head of the femur is approximately 1 in. in diameter, the neck of the capsule has a lumen of about $\frac{1}{4}$ in.; also the narrower the inside of the constriction, the greater is the thickness of its walls.

That this is no theoretical conception, but a simple fact, is demonstrated by every case which is submitted to open operation (*Fig. 333*). If, then, the constriction of the capsule is the essential obstacle to reduction, it is difficult to see how this can possibly be overcome either by brute force or by magician's

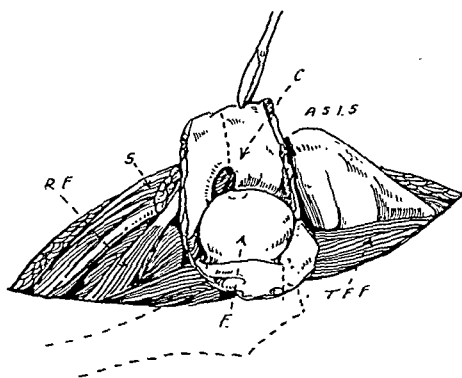


FIG. 333.—Open operation for congenital dislocation of the hip, showing constriction of the capsule. C., Capsule, showing narrow entrance to the acetabulum. S., Sartorius. R.F., Rectus. A.S.I.S., Anterior superior iliac spine. F., Femur, the neck and shaft being shown in dotted line. T.F.F., Tensor fasciæ femoris.

skill applied through the unbroken skin. Possibly the feat may be accomplished in one of two ways. Brute force may actually tear off the attachment of the capsule from the acetabular rim, and then the whole head of the femur with the capsule may be made to fit into the socket; or perhaps a less forcible but more cunning manipulation may telescope the capsule into the acetabulum, folding it up by the pressure of the head of the femur. In either of these events, which must be very unusual, it is possible that if the head of the femur be kept tightly applied to the socket for one or two years, absorption of the capsule may take place, so that at long last the head of

the femur comes to lie in its proper cavity. But, on the other hand, I venture to think that in the great majority of instances where repeated and forcible manipulations are applied to a difficult case, and the leg is then put up for a long period in an abduction plaster, reduction is not effected, and however long has been the incarceration of the limb, when the child does begin to walk he does so with a dislocated hip. The sole gain of such a long and expensive method of treatment has been to make the capsule short and thick instead of long and tubular, so that the head of the bone remains for a long time tied closely against the pelvis. I confess that I am utterly sceptical as to the efficiency of any of the complicated methods of reduction, whether they depend upon carefully correlated movements of the limb or upon the force or ingenuity of apparatus, because I cannot see how a spherical body an inch in diameter can be forced through a channel a quarter of this dimension (*Figs. 334, 335*). But cases are still being treated by these methods at a cost of one or two years of time and one or two hundreds of pounds in maintenance fees, only to lead to ultimate disappointment. In children.

then, congenital dislocation of the hip should always be treated in the first place by manipulation, and it is useful to do this with the guidance of the X rays, so that the head of the bone can be followed as it approaches and enters the acetabulum. As a general rule up to the age of 3 to 4 years manipulation under the guidance of the X rays will effect this reduction, and then if the limb is kept in an abduction plaster for about six to nine months, permanent recovery takes place, so that after a few years no abnormality can be detected in the walking, and the X rays show a normal joint, or one with a shallow socket.

2. Children from 4 to 14 Years.—In those children in whom manipulation, aided by an anæsthetic and the X-ray screen, fails to reduce the dislocation, open operation is necessary. These children are generally aged from 4 to 14 years. The hip is exposed by the anterior incision, and the head of the bone in

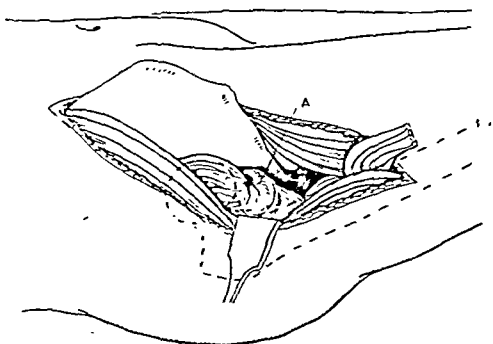


FIG. 334.—Open operation for congenital dislocation, showing the capsule from the outside. A, Constricted portion of the capsule.

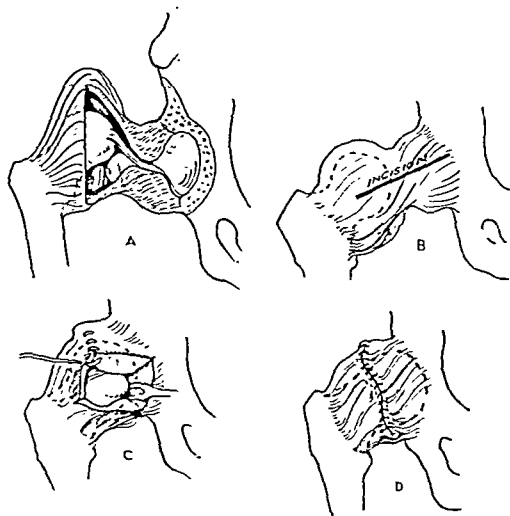


FIG. 335.—Diagram showing structure and treatment of the constricted capsule. A, Hour-glass capsule shown in section; B, Capsule divided longitudinally; C, Incision in capsule being sewn up transversely; D, Completed suture of capsule.

its capsule is usually found lying anteriorly just under the cover of the tensor fasciæ femoris. The capsule is cut open by a longitudinal incision over the femoral head, and it is found that a narrow constriction leads into the acetabulum. The incision in the capsule is prolonged through this constriction, so that the socket is fully exposed. It is now quite easy, by means of manipulation aided by Murphy's shoehorn retractor, to place the head into the socket, but it generally becomes evident that it is not likely to stay in this position because of the shallow character of the acetabulum. At this juncture three courses may be followed:—

a. The head may simply be kept in its socket by abduction of the limb fixed in plaster-of-Paris, trusting to the pressure of the head to deepen the cavity in which it lies. This plan should be used only in those cases when

the socket is reasonably well formed, as tested by its ability to hold the head when the limb is allowed to lie in the same line as the trunk.

b. The next and most obvious plan consists in deepening the acetabulum by means of a gouge or burr so as to accommodate the whole head, which is then pushed into the new socket and the capsule closed over it. This closure of the capsule will have to be in a transverse direction after the manner of a pyloroplasty, so as to overcome the constriction and at the same time to

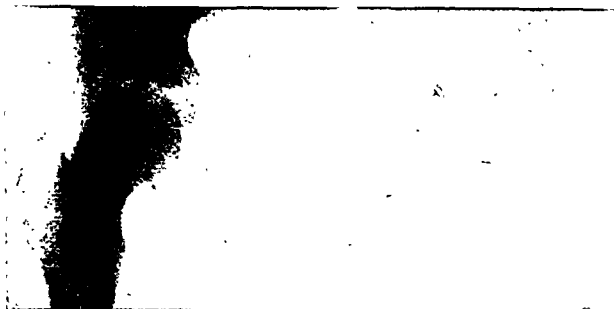


FIG. 336.—Pelvis of a girl of 10, showing congenital dislocation of the left hip.

shorten the capsule, tying the femur close to the pelvis. This method of operation has the great merit of gaining good security for the joint, and from this point of view it is the best treatment which is available (*Figs. 336, 337*). But unfortunately the price paid for this security is the danger that the joint will become fixed (*Figs. 338–340*). This is accounted for by the fact that the acetabulum is robbed of its cartilage by the act of scooping out a



FIG. 337.—The same case as *Fig. 336* treated by deepening of the socket, six months after operation. Note the evidence of partial ankylosis.

new socket, whilst the head of the bone, which has been dislocated for a long time, has a very poor cartilaginous covering. This leads to a close fibrous union occurring between the bones. In the case of a unilateral dislocation a firm but more or less fixed hip will give a good functional result, but if the deformity is bilateral then the double stiff hip will give a sadly crippled condition.



FIG. 338.—Double congenital dislocation of the hip in a girl of 12.



FIG. 339.—The same case as *Fig. 338* a few months after reduction, the sockets having been deepened.



FIG. 340.—The same case as *Fig. 339* five years after operation. There is some degree of ankylosis.

c. The third available method is to leave the natural cartilaginous floor of the acetabulum and to try to hold the femoral head in place by constructing a new shelf to the upper edge of the socket. This has been done in various ways with varying degrees of success. The method in common vogue is to take a piece of the exposed ilium adjacent to the anterior superior spine and to fix this against the upper margin of the acetabulum by a few bone nails (Fig. 341). This is not very efficient, because the bit of bone available, being only $\frac{1}{4}$ in. thick, does not give much of a rim to the socket, and also because this transplanted bone is apt to become absorbed before it can function as an acetabular lip. Another device I have

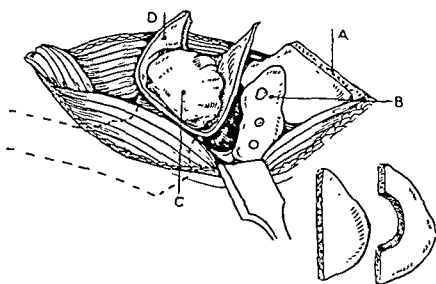


FIG. 341.—Operation for congenital hip dislocation. New rim to acetabulum made by a graft from the ilium. A, Cut edge of ilium; B, Graft nailed in place; C, Head of femur; D, Capsule. The inset shows the graft before and after shaping.

used is that of an ivory rim, which is fixed to the upper margin of the socket by a few ivory nails (Fig. 342–345). This remains in place indefinitely (that is, I have cases done four years ago) and the ivory rim becomes encased in new bone. Such a method, however, can hardly be adopted as a standard procedure, because there must be some risk of the bulky foreign body being extruded from the tissues before a new socket has been formed. In all my later cases the new rim of the acetabulum has been made by turning down a wide flap from the outer layer of the ilium. This is not merely periosteum, but a good substantial layer of bone with its covering periosteum. In order to keep it jutting out shelf-wise, one or two ivory pegs are driven

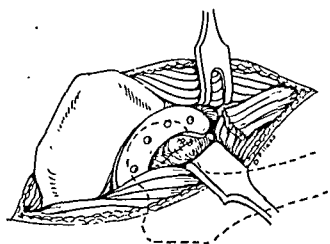


FIG. 342.—New rim to acetabulum made by a piece of ivory.

in above it. (Figs. 346–350.)

It is more than three years now since I began using this technique, and with increasing experience of the operation the results seem to be improving. The new shelf of bone above the acetabulum can be seen in the X-ray pictures to become firm and thick, and it forms the boundary of a new socket of a more shallow type than the normal. As regards functional results, the mobility of these hips remains quite unimpaired.



FIG. 343.—Hip-joint of a girl of 10, showing congenital dislocation, before treatment.

but a slight limp persists owing to the higher position of the femur and the

FIG. 344.—The same case as Fig. 343 with ivory rim in place.



FIG. 345.—The same case as Fig. 344 two years later.

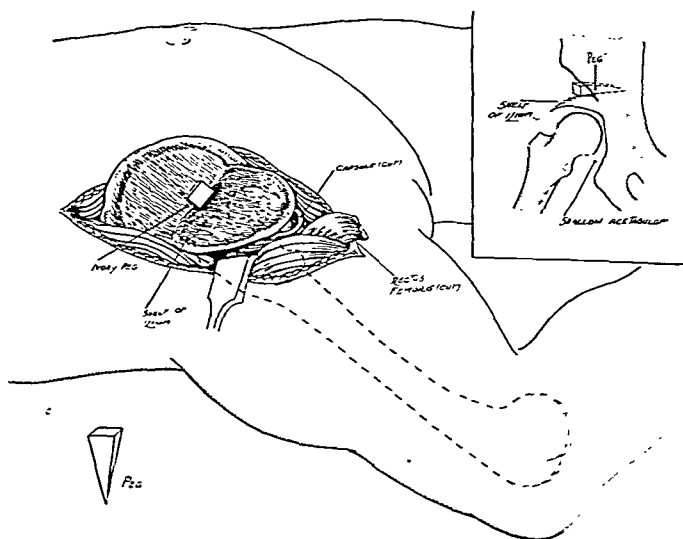


FIG. 346.—Diagram showing new rim made by turning down a flap. Inset shows the flap in profile and one of the pegs used.



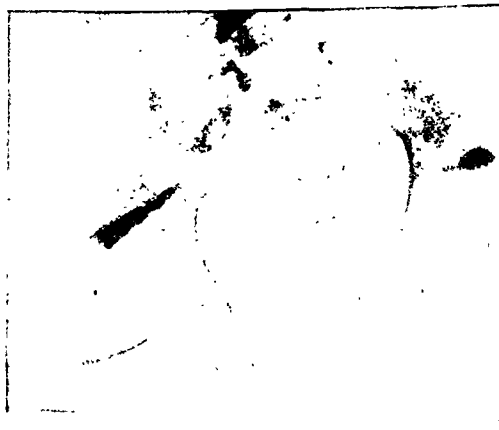
FIG. 347.—Dislocation of the hip before treatment.

FIG. 348.—The same case as *Fig. 347* one year after treatment by the method shown in *Fig. 346*.



FIG. 349.—Double dislocation of the hip before treatment.

FIG. 350.—The same case as *Fig. 349* six months after operation by the method shown in *Fig. 346*.



loose fit of the joint (*Fig. 350*). Instead of securing the flap in position by ivory pegs, two converging flaps may be made and secured by sewing their

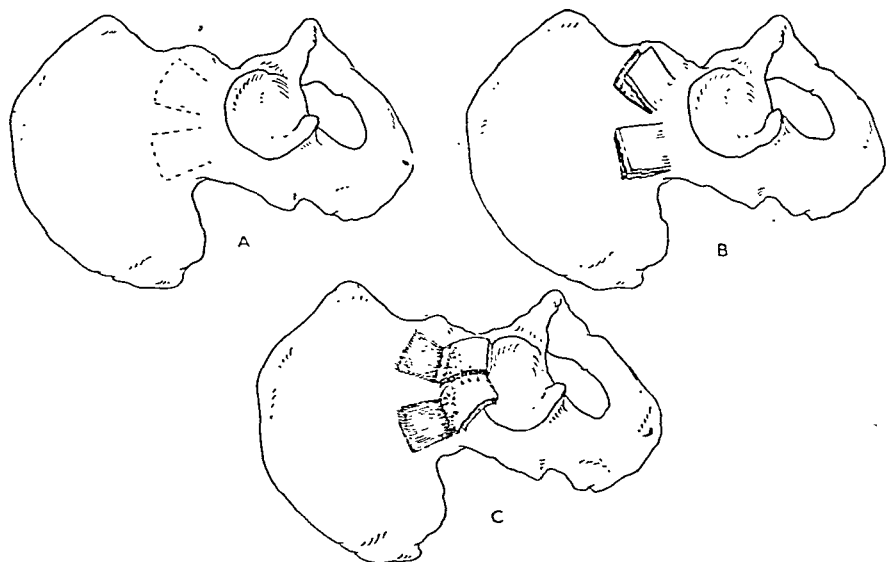
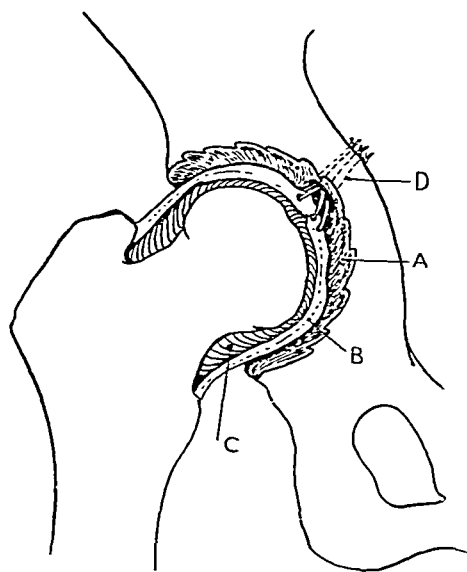


FIG. 351.—Method of making a new rim by converging bone-flaps. A. Lines of flaps ; B. Flaps raised ; C. Flaps sutured.

edges together (*Fig. 351*). Many years must elapse before the ultimate fate of the reconstructed acetabulum can be demonstrated. In the meantime we have these various methods of treating the dislocated hip which cannot be reduced by manipulation, any of which seem to me to be vastly superior to leaving the child to grow up to increasing pain and lameness.

FIG. 352.—Diagram showing deepened acetabulum with the whole capsule detached from the rim of the socket and used to anchor the head in its new bed. A. New acetabulum ; B. Capsule ; C. Synovial cavity ; D. Sutures fixing capsule round the head and brought through the floor of the acetabulum.



In the one method stability is secured by gouging out a deep acetabulum, but with a great sacrifice of the mobility of the joint ; in the other free movement is retained in a loose joint, the stability of which is uncertain, by constructing a new acetabular shelf. I still believe that by further

improvement in the technique we shall be able to attain both mobility and stability at the same time. The deepening of the socket is clearly an essential step in securing stability and will always be more efficient than building up a new acetabular rim. How, then, can the fibrous union between the head of the femur and the new socket be prevented? I am trying to effect this by

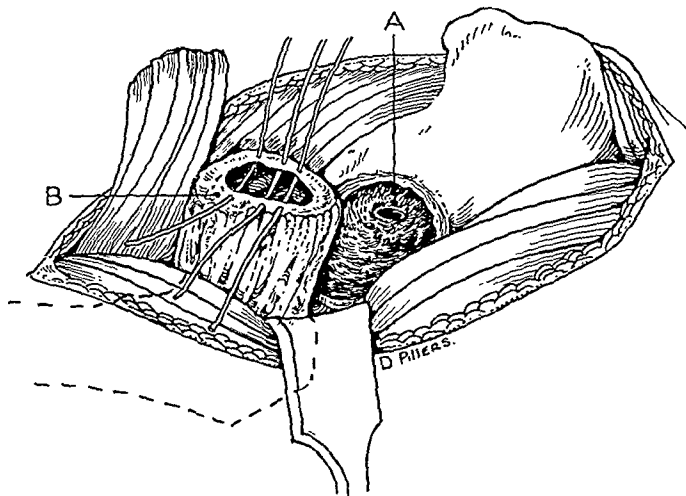


FIG. 353.—Drawing of operation for transplanting capsule inside the acetabulum. A, New acetabulum; B, Cut edges of capsule being sewn together by sutures, which are left long and then taken through a hole in the floor of the acetabulum.

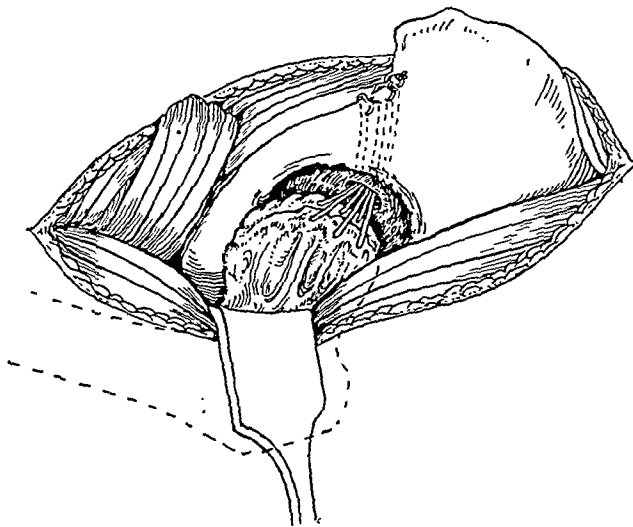


FIG. 354.—Shows sutures drawing the capsule into its new position lining the acetabulum.

the following method (*Fig. 352*). After exposing the head of the femur lying inside the capsule, the latter is not slit open, but its attachment to the rim of the acetabulum is cut away and the constricted part of the capsule is sewn together by a stout ligature so as to enclose the head of the femur by a bag

which has an exuberant margin beyond the ligature. The new socket is then made by gouging out of the acetabulum freely. The floor of this new socket is perforated by a twist-drill, the point of which is controlled by the finger inserted under Poupart's ligament and the iliacus muscle. By means of a suitably curved aneurysm needle a stout tendinous ligature is passed over the pelvic brim, through the hole in the acetabulum, and out into the thigh. The ligature is tied to the free margin of the capsule, the whole femoral head inside the capsule is placed in the new socket, and the free margin of capsule is firmly anchored to the brim of the pelvis or to Poupart's ligament. Thus, although the new socket has been deprived of its cartilage lining, it is now lined by capsule and the head of the bone is still surrounded by its original synovial sac; and, further, the strong capsular ligament with its new attachment will serve to anchor the femur to its socket instead of allowing it to wander away (Figs. 353, 354).



FIG. 355.—Congenital dislocation of the hip in a man of 20.

3. Adults.—The third group of cases of congenital hip dislocation is that of the adults in whom deformity has been endured throughout the resilient period of youth, but who at the age of 25 to 35 usually develop a painful form of osteo-arthritis in the false joint. In such a case true reconstruction of the joint is impossible, because the acetabulum has filled up, the head has become deformed, and the muscles have undergone permanent shortening. In a unilateral dislocation a great deal can be done to cure both the lameness and the pain. The leg, which is about 3 in. shorter than its fellow, is raised about 5 in. off the ground owing to the tilting of the pelvis upwards on the dislocated side, where the hip is always adducted (Fig. 355). A simple subtrochanteric osteotomy followed by forced abduction of the femur will correct the tilting of the pelvis, and by bringing that side of the pelvis down, will to some extent make good the real shortening of the leg. And, what is still more important, the weight of the body, instead of merely being slung on to the femur by the ligaments, will rest upon the thigh-bone at the point where it has been broken and bent (Fig. 356). This is the basis of what is now known as Lorenz' bifurcation operation.



FIG. 356.—The same case as Fig. 355 a year after osteotomy. The legs are now nearly of the same length, owing to abduction of the femur and tilting downwards of the pelvis.

Such an operation should be regarded as the routine treatment of all cases of unilateral dislocation in adults: but the problem is more difficult when both hips are affected. The bifurcation operation depends for its success largely on being able to

abduct the leg after osteotomy so that the pelvis will tilt over on that side and so have its weight borne more directly on the femur. Now it is clear that this cannot be done on both sides, because if both legs were abducted, they could not be parallel to one another for walking purposes. In such

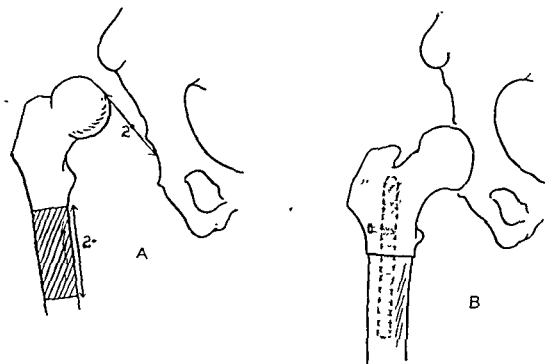


FIG. 357.—Diagram of a method of reducing one hip in double congenital dislocation in an adult. A piece 2 in. long has been removed from the shaft of the femur below the trochanters. This allows the head of the bone to be brought down into its socket.

a case I have used the following method. On the right side the dislocation was reduced by an open operation by the expedient of removing 2 in. of the shaft of the femur just below the small trochanter (*Fig. 357*). This removed the tension of all the great thigh muscles, and the upper end

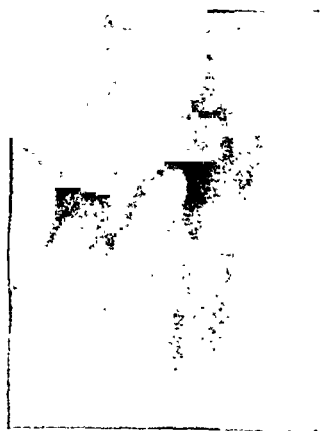


FIG. 358.—Double congenital dislocation of the hip in a woman of 30. Skiagram of the right hip-joint.

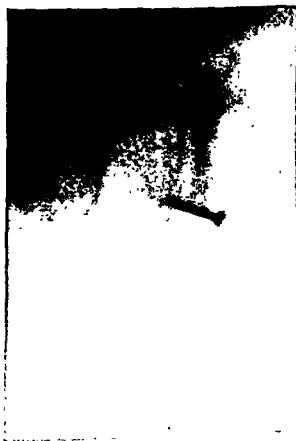


FIG. 359.—The same case as *Fig. 358* a few months after operation, the femur having been united over a peg.

of the femur could be then brought down so that its head was on a level with the acetabulum, into which it was fitted after the latter had been deepened (*Figs. 358-360*). The divided shaft of the femur was joined by an intra-medullary peg. The case was then converted into one of unilateral dislocation.

but with this important difference from the usual condition—namely, that the two legs were of the same length. The patient can now stand and walk without the use of a stick and has 45° of flexion in the hip-joint. I had intended to operate on the other hip at a later date by doing the simple bifurcation operation, but the patient is a working woman and is now free from pain, and so far satisfied with her condition that she does not feel inclined to give up further time for another operation. As the reconstruction operation was done five years ago and she is now steadily at work, it is a good tribute to its efficiency.

INFANTILE PARALYSIS AFFECTING THE HIP MUSCLES.

It is well known that when infantile paralysis involves the lower limb the most serious disability is caused by the loss of the gluteal abductors. The loss of all the muscles below the hip can be made good to a large extent by apparatus which keeps the leg rigid; but the gluteal paralysis, especially that of the gluteus medius, renders it impossible for the body to be balanced on the hip, and so makes it necessary for the patient to be always dependent upon the use of crutches. Two different operations have been proposed for this condition, depending upon the utilization of the tensor fasciæ femoris or the erector spinæ muscles respectively as substitutes for the lost glutei. In Legg's⁵ operation the tensor fasciæ femoris has its insertion into the fascia lata fixed to the great trochanter. This is a good procedure as far as it goes, but it is open to various limitations. The new muscle is comparatively small, and as its origin is in front of the line of the great trochanter, it will always tend to flex the thigh at the time that it abducts.

Kreuscher's⁶ operation utilizes the lower portion of the erector spinæ muscle. In this procedure there is the great difficulty of providing an adequate tendon to connect the muscle to the trochanter. This has been met by the use of a series of stout silk strands, which it is hoped in time will become reinforced by new fibrous tissue. Obviously, however, it is expecting a great deal to try to balance the body weight on the hips by means of silk strands.

I have adopted a combination of these two operations which seems to me to obviate the objections of each whilst it has the advantages of both (Fig. 361). A long incision is made down the outer side of the thigh exposing the iliotibial band of the fascia lata from the level of the trochanter to that of the outer condyle. The fascial band is divided just above the knee and isolated from the deep tissues up to the insertion of the tensor fasciæ femoris. It is then taken backwards through the tendinous origin of the vastus externus just below the prominence of the great trochanter. At this stage the long



FIG. 360.—The same case as Fig. 359 five years later. Both legs are of the same length.

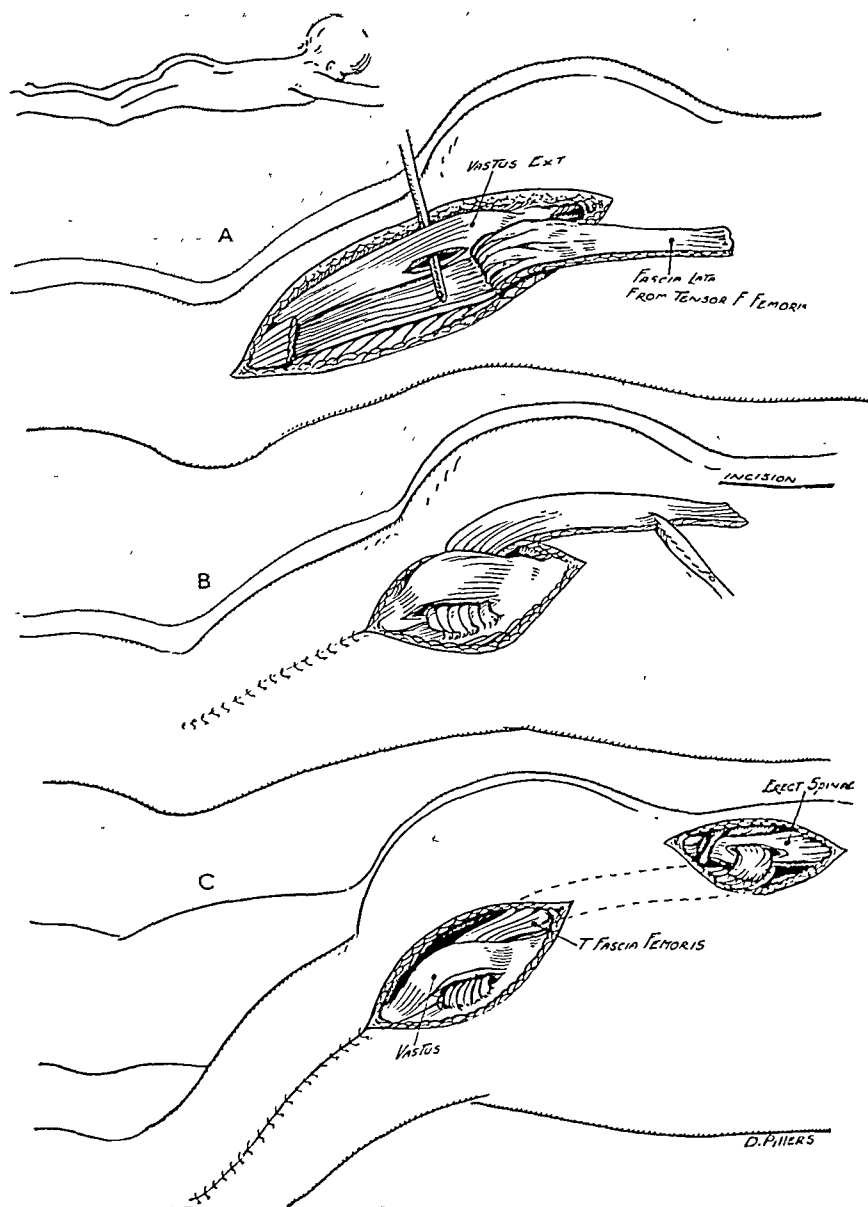


FIG. 361.—Operation for making a new abductor muscle for the hip. Inset, position of the child and incision. A, Thigh operation; the iliotibial band is isolated and divided at its lower end. A tunnel is prepared for the new tendon at the base of the great trochanter under the upper part of the origin of the vastus externus. B, A great part of the vastus under the upper part of the origin of the iliotibial band has been brought through the tunnel at the base of the trochanter. C, The superficial part of the erector spinae has been exposed and isolated; the iliotibial band has been drawn upwards and backwards under the skin and attached to the erector muscle.

incision in the thigh is closed except at the upper part. The lower part of the erector spinæ muscle is now exposed through a separate vertical incision. About half the thickness of this muscle is isolated and divided from its origin at the angle between the iliac crest and sacral spinous processes. A tunnel is made beneath the skin and subcutaneous tissues connecting the two wounds, and the iliotibial band is drawn up to the back, pulled tense, and its end is brought through the tendon of the erector spinæ, doubled back on itself, and sewn by separate stout silk ligatures, the leg being held in abduction all the time and put up in this position after the closure of the wounds and the conclusion of the operation (Fig. 362). The new muscle which now forms an abductor of the hip-joint is a digastric muscle having the erector spinæ forming its posterior, and the tensor fasciæ femoris its anterior, belly, whilst the strong fascia lata forms the intermediate tendon. Acting together the two components of this muscle will be a pure abductor, whilst the anterior belly will also be a flexor, and the posterior an extensor of the thigh.

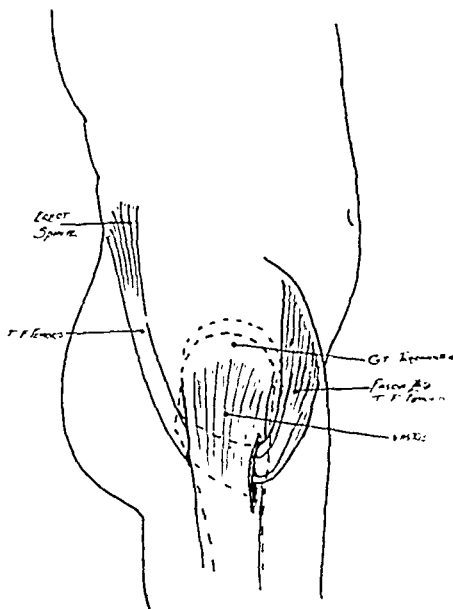


FIG. 362.—Diagram of the new abductor muscle of the hip seen from the side.

In concluding this article, I have to express my grateful thanks to Miss Pillers for the care and skill she has bestowed upon the preparation of the illustrations, which form, I think, its most valuable feature.

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EXPLORATORY LAPAROTOMY AND APPENDICECTOMY IN CHRONIC AMŒBIC DYSENTERY.*

By VINCENT COATES, BATH, AND ERNEST W. HEY GROVES, BRISTOL.

THE following considerations have led us to estimate the desirability of exploratory laparotomy in picked cases of chronic amœbic dysentery: (1) The ubiquity of the *Entamœba histolytica* as reported in the medical journals from time to time. (2) The specific pathology of amœbic infection of the bowel, which is such that there is segregation of amœbæ in blind alleys of the mucous membrane sealed off from the lumen of the bowel by exudate till ulceration occurs. (3) The limited area of mucous membrane exposed to view by the sigmoidoscope. (4) The only occasional success in diagnosing correctly by radiogram localized intestinal lesions amenable to surgical treatment. (5) The repeated failure in many instances to cure or alleviate chronic amœbic dysentery by medical treatment, however protean and varied.

Three cases have been explored surgically. In all three the appendix was removed, and smears from its mucous membrane demonstrated from 8 to 20 amœbæ per microscopic field. In one case the gall-bladder was drained and amœbæ were discovered in the bile. In all three cases amœbæ disappeared from the stools. In *Case 2*, in which the gall-bladder was drained, the attacks of hepatitis were affected favourably both in the matter of lengthening of free intervals and in severity, and in *Case 3* a desperately ill man was made convalescent.

Case 1.—X., age 33. Complained of tenesmus and frequent passage of blood and mucus. There had been a Flexner-Y infection in April, 1917; agglutination tests were negative; the stools showed much blood-stained mucus, suggestive of old bacillary ulceration, though cultures were negative.

On April 12, 1926, vegetative amœbæ were found. There was nothing to note in systemic examination, except palpable and tender colon. An intensive course of subcutaneous emetine, auremetine and stovarsol by mouth, and emetol in ether and olive oil per rectum made no impression.

OPERATION, June 14.—Appendicectomy was performed. The stump of the appendix was fixed to the surface incision, through which irrigation was performed. Many amœbæ were found in smears from the appendicular mucous membrane. The amœbæ disappeared from the stools, which otherwise remained *in statu quo*. The general health improved very slightly.

Comment.—A case of double infection, bacillary and amœbic, which in all likelihood would have responded better to colostomy in addition to appendicectomy.

Case 2.—Y., age 31. Admitted on Jan. 5, 1925, complaining of attacks of pain in right shoulder and right chest with night sweats, every six weeks. Duration

* From The Ministry of Pensions Hospital, Bath.

many months. Free from symptoms on admission. There were no physical signs except finger-clubbing and poor air-entry at the right base. He was apyrexial. A radiogram showed generalized fibrosis of the lungs, most marked at the right base. The sputum was negative on ten occasions: Wassermann reaction negative.

On Jan. 22 amœbæ were found in the stools. An intensive course of emetine periodide produced negative stools.

On Feb. 18 he had an attack of hepatitis. Temperature 102° . Blood-count showed 26,200 white cells, of which 69.5 per cent were polymorphonuclear leucocytes.

He reacted well to emetine hydrochloride, 1 gr. bis die sub cute, and was discharged with full notes to the clinic.

The patient was readmitted to hospital and seen in further attacks similar to the above in character. He reacted to emetine, and there was absence of localized hepatic signs.

OPERATION, Sept. 7.—A right-angled incision was made at the origin of the right rectus at the xiphisternum, passing laterally to the 10th costal cartilage. Skin flap, rectus, and sheath were folded downwards, the peritoneum was incised, and the abdomen entered. The cæcum showed a granular patch the size of a shilling above the root of the appendix. The appendix was injected, long, and thickened, and was removed. The sigmoid was large. The liver was large and soft, and bled easily on gentle manipulations. There was a yellow patch the size of a threepenny piece on the upper superficial margin of the right lobe. No adhesions were found and no localized abnormality. The gall-bladder, which was small and engorged, was drained.

Smears from the appendicular mucous membrane showed many amœbæ, and they were found in bile from the gall-bladder for five days. The subsequent course was satisfactory.

The patient had one minor attack of hepatitis controlled by emetine, and with stools positive, on Nov. 1, but the stools became negative subsequently after a course of treatment. He was discharged with biliary fistula on Jan. 8, 1926. The case was reviewed on April 21, and there had been no attack of pain since his discharge.

Comment.—A particularly instructive case, where elimination of two culs-de-sac was instrumental in restoring earning capacity to approximately 100 per cent.

Case 3.—Z., age 34, was admitted on Feb. 27, 1926, grossly ill, with tenesmus, tormina, and hourly stools mainly composed of blood, pus, and mucus. There was a slight degree of prolapsus ani. The patient, who had served in the Balkans and Russia, had dysentery in 1918. He was now emaciated, grey, and collapsed.

Amœbæ were found in the stools. Culture was negative to dysentery and typhoid groups. No tubercle bacilli in stools; agglutination tests negative. Complement-fixation tests for tubercle and syphilis negative.

He could not tolerate auremetine by mouth or rectal irrigations. After morphia suppositories, champagne and hypnotics and sodium sulphate at frequent intervals, he tolerated a modified emetine course, and, subsequently, a further more intensive one. The stools remained positive.

OPERATION, July 7.—The abdomen was opened by a right rectus incision. The gall-bladder, liver, and spleen were normal. The appendix, which was moderately kinked and bound down, was removed. The whole of the cæcum and the ascending, descending, and sigmoid colon was inflamed, especially distally, and much thickened. The tinææ were grossly hypertrophied and stood out like cords. A transverse colotomy was performed, and subsequently a Paul's tube was inserted.

No amœbæ were found on puncture of the gall-bladder, but the appendix showed many of these in its mucosa. Irrigations of permanganate of potash and protargol

were instituted daily, as well as emetol in liquid paraffin. The stools improved very much in appearance, odour, and frequency, and amœbæ have not been found since the operation. At the time of writing the patient is up and about, has put on weight, and feels well. He has an open colostomy wound.

Comment.—The appearance of the large intestine was astonishing, and bore out the impression given before operation that surgical treatment offered the only hope of recovery. The appendix in this instance also appeared to be the jumping-off point for amœbæ.

CONCLUSIONS.

1. The possibility of a specifically infected gall-bladder or appendix acting as a release station for amœbæ should be considered in cases of amœbic dysentery not yielding to medical treatment.

2. There is evidence that, in certain picked cases of this type, removal of such incubation centres has mitigated the course of the disease.

3. Laparotomy is the operation of choice, and the surgeon should be given a free hand to perform cholecystostomy, appendicostomy, or colostomy in addition to appendicectomy as occasion seems to warrant.

We wish to thank the Director General of the Ministry of Pensions Medical Services for permission to make this publication.

CARCINOMA OF THE ILEUM.

BY J. J. ROBB, BRISTOL.

CARCINOMA of the small intestine is admittedly somewhat rare, and, judging from a perusal of the literature relating to this lesion, it is still more rare to find it in parts of that gut distant from either the caecal or duodenal extremities. The nearer one approaches the junction between the ileum and the jejunum, the rarer the condition appears to become. The following case is presented because in its situation it approaches that region of small intestine which, but for such cases, might almost be termed immune to cancerous growth.

CASE REPORT.

The patient was a woman, age 64 years, who came under the care of Mr. Hey Groves in September, 1922.

HISTORY.—The patient's complaint was that six months previously she had commenced to have abdominal discomfort and flatulence. Recently her

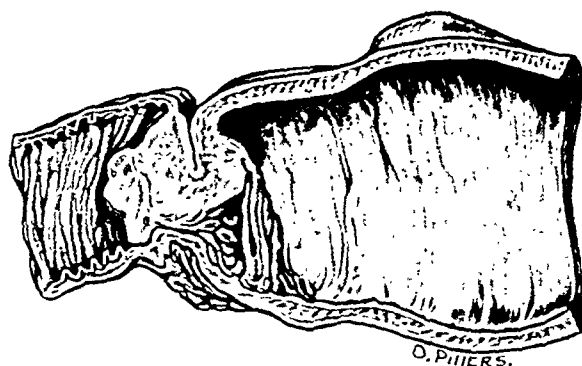


FIG. 363.—Carcinoma of the ileum. The proximal segment of the bowel lies to the right. Extension of the growth has taken place mainly into the lumen, forming a polypoid mass and causing a ring constriction. At the upper part of the stricture the growth has invaded the serous coat. (*The specimen is now in the R.C.S. Museum.*)

appetite had become poor, and occasionally she had attacks of sickness and vomiting. She had lost much weight and was now thin.

ON EXAMINATION.—There was moderate distention of the abdomen, and coils of intestine could be distinguished. Peristalsis was not visible; the liver dullness did not come below the right costal margin. Per rectum nothing abnormal could be distinguished, and melæna was absent. A provisional diagnosis of chronic obstruction was made and operative treatment recommended.

OPERATION.—Through a median incision below the umbilicus the distended gut was found to be purely small intestine. A small amount of free fluid was present. The caecum was empty, and further examination revealed a ring constriction about the middle of the ileum. This was excised together with 3 in. of bowel on either side and a V-shaped portion of mesentery. An end-to-end anastomosis was then performed. The left ovary, which was enlarged and hard, was also removed. The right ovary was normal. A section from the left ovary gave the picture of a fibroma.

PATHOLOGICAL EXAMINATION.—An examination was made of the constricting portion of small intestine. At the site of the stricture there was an

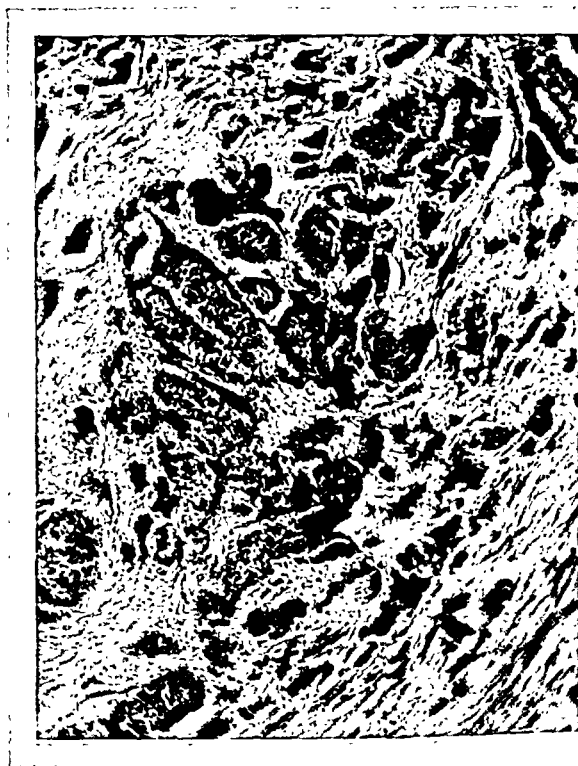


FIG. 364 —Low-power view of section of growth, showing permeation of lymphatics.

inward projecting mass of tissue, which on section showed a highly cellular spheroidal-celled carcinoma (*Figs. 363, 364*). It was growing much more towards the lumen than along the walls of the gut. The lymphatics in the muscular coats at the base of the tumour were infiltrated. Only in one area of the ring stricture was the peritoneal coat invaded by malignant growth. Its spread towards the lumen and its tendency to pass down the lumen caused the stricture, and not its chronicity. There was very little evidence of fibrosis. The highly cellular and undifferentiated nature of the tumour suggested a rapidly growing neoplasm.

SUBSEQUENT HISTORY.—In the first week of November, 1926, I had the opportunity of examining this patient. She now looks very well, and has added considerably to her weight. Her life is an active, busy one, but she feels quite equal to it, and in every respect is free from symptoms. On examination nothing abnormal can be either seen or felt.

Presenting this case in conjunction with other recorded cases, I venture to give a short account of the main symptoms. There is usually a preliminary history of vague abdominal discomfort, with a varying distention, lasting in the average case from three weeks to six or eight months. These symptoms do not obtrude themselves very markedly upon the attention of the patient, and call for little further remedy than the loosening of some constricting garment. This early lack of evidence of so malign a condition is doubtless due to the fluidity of the intestinal contents. Pain is absent because there is neither trauma nor infectivity of bowel contents sufficient to erode the invading growth, and for the same reason melæna is absent, and also its usual accompaniment, a secondary anæmia. Hence, until obvious obstructive symptoms commence there may be little available evidence to call one's attention to the serious nature of the lesion present.

Once a true progressive obstruction is established, either by stenosis of the small bowel or by a polypoid mass, the symptoms become more characteristic: distention with abdominal pain, vomiting and increasing constipation, often marked emaciation, and loss of appetite. Neither visible peristalsis nor melæna appears to be present as a rule until the very late stages.

Generally these cases are first seen with the symptoms of a subacute obstruction of the small bowel, but may appear as an acute obstruction, particularly where an intussusception has resulted from the passage of the polypoid type down the lumen of the intestine.

In searching the literature on this subject, whether British, American, or Continental, one is at once struck by the rarity of the cases where an actual diagnosis of carcinoma of the small bowel was reached prior to operation. In several cases a bismuth meal and X-ray picture failed to demonstrate its presence. The more one reads, the more one is driven to the conclusion that the whole clinical picture is such that it betrays one's clinical sense; so often the patient has none of those symptoms that suggest the possibility of a cancerous condition. In this article particular stress is laid upon symptoms and the question of diagnosis, because little attention up to the present has been given to their interest—the interest of correlating the pathology and its situation with the clinical picture, most writers being content to point out one or other feature of the condition as being unusual. In collecting the cases on record it will be seen that carcinoma of the small bowel is about twice as common in men as in women, and rather more than twice as common in the ileum as in the jejunum.

It is impossible to be dogmatic about the question of prognosis from records which vary in details and are sadly lacking in length of post-operative history. From what immediate evidence is available two points suggest themselves: (1) The earlier the case receives treatment, the less is the operative risk, and the more certain is the recovery; and (2) The higher up the small bowel the growth is, the worse is the outlook.

Macroscopically one can place these primary growths all under one of three varieties—namely: (1) Stenosing or ring stricture; (2) Polypoid; (3) Multiple carcinomata or carcinoids. Degenerative changes may be found, particularly in the first two types, such as ulcerative and colloid. Cytologically they are columnar- or spheroidal-celled carcinomata. The type of cell present, again, gives us no guide to prognosis, about equal numbers producing metastases either at or shortly after operation.

I have neither particularly included nor discussed the question of the carcinoid in this article, because from a diagnostic point of view it in no way varies from the true carcinoma, and writers are satisfied that if removed its prognosis in no way varies from the well-recognized carcinoid of the appendix.

I wish to express my indebtedness to Professor Hey Groves, who kindly permitted me to present the features of this case for publication.

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*SHORT NOTES OF
RARE OR OBSCURE CASES*

A RARE CASE OF INTESTINAL OBSTRUCTION.

By CECIL P. G. WAKELEY, LONDON.

INTESTINAL obstruction due to malignant stricture of the small intestine is a very rare condition. On examining the surgical and post-mortem records at King's College Hospital for the years 1900 to 1923 inclusive, only two cases of carcinoma of the small intestine are to be found, and in one of these the diagnosis was not confirmed by microscopical examination. The case reported below is of interest, not only on account of the rarity of the condition, but also because of the difficulty in the actual diagnosis. The following is the history of the case :—

Mrs. E. T., age 53, first complained of abdominal pain in October, 1923, ten months after her menopause. The pain was chiefly in the epigastrium, but was often referred to the hypogastrium. On examination a large uterine fibroid could be palpated in the hypogastrium. She was admitted to the Samaritan Hospital, and in January, 1924, my colleague Mr. W. Gilliatt performed a subtotal hysterectomy for fibroids; the left ovary was removed because of its cystic condition, and the appendix was also removed. There was no sign of obstruction, and the intestine was not distended.

In April, 1924, four months after her operation, the bowels began to be troublesome, very strong purgatives having to be taken to produce an action. The abdomen became distended, and there was occasional vomiting. The abdominal distention became more marked, and the patient was admitted to King's College Hospital on May 1, 1924. On examination, the abdomen was very distended except in the flanks; the signs seemed to point to obstruction in the small intestine. A specimen of the vomit was examined, and considered to be a regurgitant vomit from the small intestine owing to the presence of fatty acids and soaps. A provisional diagnosis of obstruction to the lower part of the small intestine was made, and the question as to whether the terminal loop of the ileum had become adherent to the stump of the cervix was raised. This, however, was ruled out of court because of the long time which had elapsed between the operation of subtotal hysterectomy and the commencement of symptoms of obstruction. As the symptoms did not improve, a laparotomy was decided upon.

On May 3 the operation was performed under stavaine anaesthesia, a little open ether also being given. The abdomen was opened just to the right of the mid-line by a sub-umbilical incision. The small intestines were found to be distended, while the large gut was collapsed. A small, hard, annular growth

was found in the ileum about $1\frac{1}{2}$ in. from the ileocaecal valve. The stump of the cervix was quite free, and there were no adhesions in the pelvis. A lateral anastomosis was performed between the lower part of the ileum and the upper part of the ascending colon, and the abdomen closed. The wound healed soundly and the abdominal distention disappeared. On May 19 the abdomen was again opened under stovaine and ether anaesthesia, by a right rectus incision. The short-circuited portion of the gut was excised, namely, the last six inches of the ileum, the caecum, and the lower part of the ascending colon. The abdomen was closed in three layers. Recovery was uneventful.

FIG. 365.—Specimen after removal. The constriction can be seen just proximal to the ileocaecal junction.

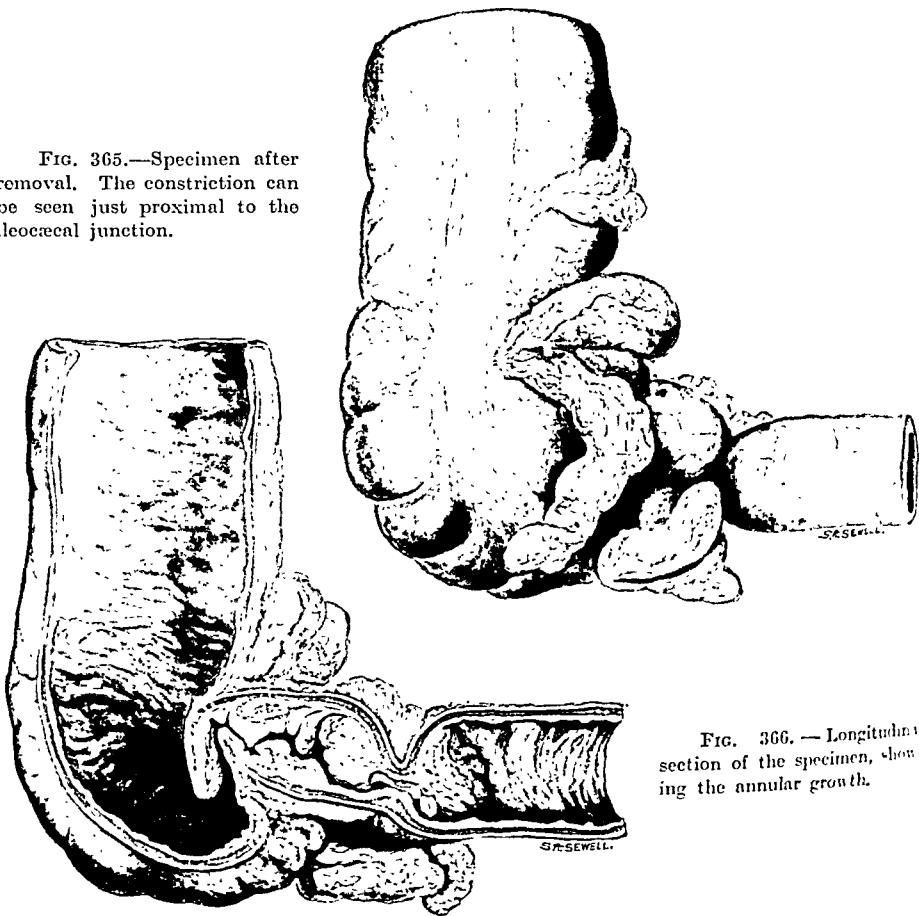


FIG. 366. — Longitudinal section of the specimen, showing the annular growth.

The tumour (*Figs. 365, 366*) formed a tight annular stricture, and on microscopical examination proved to be a columnar-celled carcinoma. There was no sign of growth in the glands at the root of the mesentery or in those in the ileocaecal angle.

When seen last in June, 1926, the patient was in good health. The abdomen was soft, and there was no evidence of any secondary deposits. The bowels were open once a day, and there had never been any irregularity since the last operation.

STRANGULATED HERNIA IN AN INFANT OF 5 DAYS.

BY S. J. H. GRIFFITHS, BRISTOL.

RECORDS show that the occurrence of a true strangulation of a hernia in infants is an event of extreme rarity. Estoci¹ conducted an exhaustive inquiry and found that in 139,000 cases upon which herniotomy was performed in children there was no record of the operation being performed for strangulation. Anel's analysis of 10,000 cases of herniotomy performed at the Edinburgh Children's Hospital includes no instance of complete strangulation. Fraser² advances the belief that the early incidence of a strangulation is related to the attempt at natural closure of the processus vaginalis. The local evidence of the attempt is a fibrous ring which is the constricting factor producing the strangulation. The following case not only tends to support Fraser's theory, but appears to be of sufficient interest and rarity to be worth recording.

H. C., a male child, age 5 days, was admitted to the Hackney Hospital at 5.30 p.m. on July 17. The child was apparently normal at birth. It had vomited several times since birth. On July 16 the nurse noticed that the left testicle was swollen, and on the day of admission that it was tender to the touch. The bowels were open the day before admission.

ON ADMISSION.—There was a tense swelling in the left side of the scrotum extending into the inguinal canal. The skin over the swelling was somewhat reddened. After unsuccessful attempts at reduction by taxis the diagnosis of irreducible hernia was made, and the child placed in a cot with its feet suspended from a gallows and an icebag applied to the swelling. At 8.0 p.m. there was no sign of reduction, and as the child had vomited several times and the redness of the swelling was increasing, the diagnosis was altered to that of strangulated inguinal hernia and operation thought to be imperative.

OPERATION.—Under gas and oxygen anæsthesia an incision was made over the swelling. Upon opening the sac about 9 in. of somewhat lustreless discoloured and distended small gut was found. The testicle was swollen and œdematous. With difficulty a hernia director was passed and the constriction, a fibrous ring at the neck of the sac, divided. The site of constriction showed several petechial hæmorrhages. The gut was considered viable and returned to the abdomen. The sac was ligated and removed, and the inguinal canal closed by suturing the conjoined tendon to Poupart's ligament posterior to the cord. The aponeurosis of the external oblique together with the fascia of Scarpa and Camper were sutured in one layer with catgut anterior to the cord. The skin was closed with continuous Japanese silk. The following day the child passed a quantity of blood per rectum and vomited three times. After that its convalescence was uninterrupted, and it was discharged five days after the operation in order that it might resume breast feeding.

I am indebted to the Medical Superintendent, Dr. W. Brander, and to Dr. G. M. Gray, late Resident Medical Officer of the Hospital for Sick Children, Great Ormond Street, who kindly administered the anæsthetic and gave much helpful advice as to the post-operative feeding.

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A CASE OF STRANGULATED OBTURATOR HERNIA.

By G. L. WALKER, LEEDS.

S. A., a somewhat frail old lady, age 73, was admitted to the General Infirmary at Leeds under my care. The history was one of abdominal pain and colic of several days' duration, with persistent pain down the front and inner side of the right thigh. Shortly before admission the failure to pass flatus, together with increasing abdominal distention and vomiting, made a diagnosis of intestinal obstruction fairly certain. An examination of all the hernial orifices gave no information; the possibility of an obturator hernia was considered very likely, and it was decided to open the abdomen.

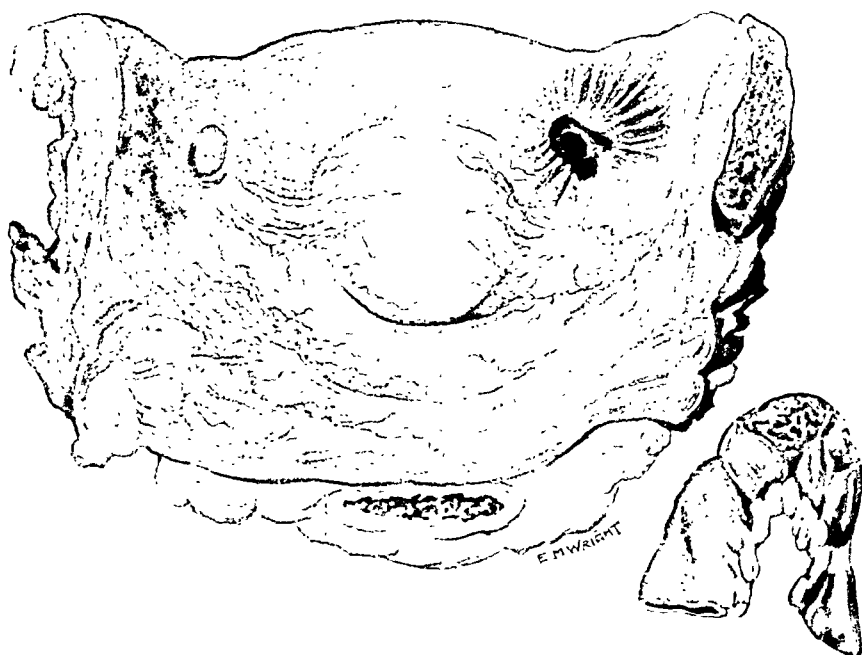


FIG. 367.—Showing the front wall of the pelvis and the knuckle of gut.

An incision was made in the middle line of the abdomen under local anæsthesia, supplemented later by general anæsthesia, and a knuckle of small intestine was found held down in the right obturator canal. It was freed and the gangrenous portion of the gut wall was infolded. Lateral anastomosis was performed on the loop of intestine.

Unfortunately the patient did not rally well, and died a few hours after relief.

Fig. 367 shows the specimen removed. The infolding of the gut has been undone, and the appearances suggest that the bowel has been a long-continued occupant of the hernial sac, with a recent strangulation of Richter type.

THE LATE RESULTS AFTER AN OPERATION FOR EXSTROPHY OF THE BLADDER.

BY T. A. ROBINSON AND GORDON S. FOULDS, TORONTO.

It is not our intention to discuss the relative merits of the various types of operation devised in the treatment of exstrophy of the bladder, but rather to report the present condition of one of the original five cases operated on by the late Dr. George Peters by the method described by him. In 1901 Peters¹ published the report of his first case which had been operated on in 1899 for exstrophy of the bladder and prolapse of the rectum. In 1902 three more patients were operated on. His last case, the subject of this report, was treated in 1903 and 1905. The account of this last patient was published in 1908 by Starr² after Peters' death. At this time four of these original cases were alive and in good health.

REPORT OF THE CASE.

George R., age 23 years, a lather by trade, was admitted to the University surgical wards of St. Michael's Hospital, Toronto, on Dec. 6, 1924. He complained of pain in the right loin and loss of weight and strength. For one month he had had pain in the right side of the abdomen. At first it was crampy in character, but later became steady and boring. About one week before coming to the hospital the pain had extended up into the right loin. He had been confined to bed for two weeks.

HISTORY.—The patient was born with ectopia vesicæ. When 16 months old, he was admitted to the Hospital for Sick Children on March 9, 1903, because of a left inguinal hernia, which was reduced under general anæsthesia. The hernia recurred ten days later. A herniotomy was done on this occasion by Dr. G. A. Peters, and the patient left the hospital on April 28.

On June 28 he was again admitted to the Hospital for Sick Children for prolapse of the rectum. Dr. Peters operated on him according to his original method,¹ opening through the left iliac fossa. About half a dozen sutures were placed in the bowel so as to constrict its lumen. The bowel was then stitched to the fascia covering the iliacus muscle. The patient made a good recovery and left hospital on July 6, 1904.

On Oct. 13, 1904, he was again admitted to hospital, but his general health precluded operation until Jan. 24, 1905, on which date the ureters were transplanted by the extraperitoneal method into the rectum, and the remainder of the bladder wall was ablated. His recovery was slow, but by April 24, the abdominal wounds were healed and the patient was discharged from hospital in good condition.

Since then he attended school from the age of 7 until he was 14 years old. He later worked as a messenger boy, and afterwards for one year made

his living wrapping parcels. For the past three years he has worked as a lather. During these years he has had fairly good control of the general bowel content, but occasionally the sphincter ani would fail to retain the urine.

ON ADMISSION.—The temperature was 101.2°. There was a mass in the right loin which extended forward to the abdominal wall. It was very tense, painful, and tender. There was moderate œdema of the back over the mass. The heart and lungs were apparently normal. The white blood-count was 18,000.

OPERATION.—Under general anæsthesia an incision was made just below and parallel to the 12th rib. About a quart of foul pus was evacuated from the perirenal tissue and from the kidney. The pelvis of the kidney which was open contained calculous material. The ureter was dilated to about $\frac{3}{4}$ in. in diameter and contained soft calculous masses. Two drainage tubes were inserted, and the wound was closed.

POST-OPERATIVE COURSE.—The patient made a fair recovery. Moderate amounts of pus discharged from the wound for three weeks, and afterwards a small sinus persisted.

Studies of the renal function were made, and the blood-urea nitrogen was found to be 20 mgrm. per 100 c.c. of blood on April 20, 1925. It was our intention to remove the kidney later, but on consideration it was decided that further interference was inadvisable on account of a transitory infection which occurred in the left kidney. The patient is now continuing his trade, and is in fairly good health despite the small sinus, which persists. X-ray examination before discharge showed no evidence of stone in the left kidney, but some calcareous material persisted in the right renal area.

According to Mayo and Walters,³ statistical records show that 50 per cent of all persons with this unfortunate developmental defect die, if unrelieved, before the 10th year, and that 66 per cent die before the 20th year. That four of Peters' five cases survived until 1908 at least, and that this case should be alive and able to carry on in his trade twenty-one years after his operation, seems worthy of record.

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- ² STARR, F. N. G., "Exstrophy of the Bladder: the Peters Operation", *Canad. Jour. of Med. and Surg.*, 1908, xxiv, 132.
- ³ MAYO, CHARLES H., and WALTERS, W. W., "Transplantation of Ureters into the Rectum. End-results of Thirty-five Cases of Exstrophy of the Bladder", *Jour. Amer. Med. Assoc.*, 1924, lxxxii, 624.

A CASE OF ENCRUSTED CYSTITIS.

By ALEX. E. ROCHE, London.

WE read in Cabot's *Urology* that "an occasional complication of a rebellious alkaline cystitis is encrusted cystitis": that "the pathogenesis of this disease is no more definitely understood than is that of encrustation elsewhere"; that "a characteristic and almost pathognomonic symptom is the repeated passage of calcareous material in the urine"; and that "most of the afflicted individuals have been finally forced to undergo surgical interventions".

A case illustrating these points is that of C. P., a builder, age 42, admitted to St. Peter's Hospital, Covent Garden, on Feb. 15, 1926, under the care of Mr. Swift Joly, to whom I am indebted for permission to publish it.

HISTORY.—The complaint was of pain on, and increased frequency of, micturition, and also of the passage of stones and 'blood-streaked jelly'. The past history vouchsafed included six months' residence in Egypt during the war (where he had one catheter-relieved stoppage); pneumonia and malaria; but not venereal disease.

About two years before being admitted to St. Peter's Hospital, the commencement of slowly progressive increased frequency of micturition was noticed both by day and by night, occurring finally at half-hourly intervals. About nine months before admittance, the patient passed a white stone with pain, and, since then, large numbers of stones, about fifty in the last five weeks (nine during the last week), the passage of each stone being painful and accompanied by dribbling.

There had been occasional dull hypogastric aching for three months and occasional median dorsal pain, but no lumbar or testicular pain. There was no pain on micturition as a rule, though this was preceded by pain at the tip of the penis and in the rectum; there was no difficulty, except on the passage of stones, and no intermittence of the stream; there was urgency, with incontinence if the bladder was not very soon emptied. The urine had been occasionally blood-stained during one month. The patient had had frontal headaches, not worse recently, for two or three years, but no shivering, nausea, or vomiting. Thirst and appetite were normal; the bowels had been constipated for two years.

ON EXAMINATION.—The patient looked well. The external urinary meatus was red and oedematous; there was no delay, but rather precipitancy, on micturition, and the stream was of fair size. The urine was blood-tinged, contained threads, and was alkaline. There was hypogastric tenderness, and the urethra was tender, but admitted the cystoscope, which revealed two ounces of residual urine; it had to be withdrawn on account of great tenderness on irrigation. On one occasion crepitus was detected on examination per rectum. A radiogram (*Fig. 368*) by Mr. E. A. Collingridge, on Dec. 24, 1925, shows the semicircular outline of the bladder, calcified in its upper part, the prostatic and renal regions being clear of stones.

OPERATION.—At the operation by Mr. Swift Joly on Feb. 17, 1926, cystoscopy was impossible because of bleeding. A suprapubic cystostomy was performed, and much calcareous matter was found studding the upper half of the bladder, the wall of which was here thickened, velvety, irregular, and finely papillary and nodular, yet quite flexible, and not hard as in carcinoma. The adherent calculous material was scooped off, and similar material, free in the bladder cavity, removed. A de Pezzer tube was tied into the bladder, and a No. 24 (French) catheter into the urethra. Three days before the patient's discharge from hospital on March 15 he passed two small calculous flakes $\frac{1}{8}$ by $\frac{1}{16}$ in. in size.

The localization of the calcifying process to the superior wall of the bladder is curious. The residence of the patient in Egypt might suggest bilharziasis as

the basis of the cystitis, were it not for the complete absence of symptoms until at least six years afterwards (with the exception of an isolated retention of urine, the cause of which is obscure). The history and aspect of the patient were unlike those usually met with in carcinoma, which, though not considered at the operation to be present, could not even then be definitely excluded; its presence or absence was to be determined by the further progress of the case.

SUBSEQUENT HISTORY.

—The subsequent history is that, since May 3, the patient, who was treated with hexamine and bladder

FIG. 368.—Radiogram showing a semicircular shadow of calcareous deposit on the vault of the bladder.

washes, had occasional slight suprapubic leakage; this prevented cystoscopy, as the irrigating fluid escaped when the bladder contained only one ounce. Before May 3 the patient passed one very small piece of calculous material, but has passed none since, and a radiogram taken on June 3 shows no trace of any abnormal shadow in the bladder region. Since May 17, when the urine was still turbid and alkaline, he has been taking hexamine and acid sodium phosphate.

On July 12 the fistula was cauterized down to the bladder with silver nitrate, after which there was less suprapubic leakage. On Sept. 6 the urine was noticed to be clearer, and, for the first time, acid, this acidification being evidence of the diminution of the severe infection (of which a right epididymitis on leaving the ward, and a left epididymitis at the end of

July were further manifestations), and a sign of prime prognostic importance as a guarantee against the recurrence of the phosphatic accumulations, the deposit of which postulates alkalinity of the urine.

On Sept. 29 the suprapubic fistula was completely excised by Mr. Joly, as was also an abscess cavity under the rectus sheath in front of the bladder. There was much pericystitis. The bladder, which felt smooth and soft, was freed from the pubes, to which it was adherent, and completely sewn up, a catheter being left in the urethra. On the seventh day the patient had a right epididymitis, which subsided in three to four days. He was discharged from hospital on Oct. 22, since when he remains suprapubically dry. He has passed no calculous material and has had no pain since May; his weight remains normal, he looks extremely well, and his bladder is known to be soft and smooth, so that carcinoma is excluded.

The case is interesting as illustrating a rare condition, the causation of which is obscure, and the localization curious; it is also gratifying in the relief afforded to the patient from peculiarly unpleasant symptoms.

A CASE OF MULTIPLE URINARY LESIONS.

BY ALEX. E. ROCHE, LONDON.

THE rule not to diagnose the presence of two lesions when one might suffice to explain the symptoms, though excellent as a general guide, has exceptions, to the possibility of which one must always be alive. When urethral stricture prevents cystoscopy, especial caution is necessary, insidious carcinoma of the bladder being found as an occasional concomitant. The presence of multiple lesions is well illustrated by the case of J. H., an ex-builder, age 78, admitted to St. Peter's Hospital, Covent Garden, on Jan. 9, 1926, for permission to report which I beg to thank Sir John Thomson-Walker.

HISTORY.—The patient had had gonorrhœa at the age of 28, and his complaint was of difficulty and pain on micturition. He had had very slight difficulty on micturition for twenty years; this had been progressive till Nov. 5 1925, when a fine stricture was found, and gradually dilated from 2 to 14 (French) by Dec. 17. On Dec. 18 he had retention of urine, relieved by a metal catheter, when grating was felt.

Radiograms by Mr. E. A. Collingridge showed that the renal regions were clear, but that there were many prostatic calculi, and also two large vesical calculi, the lateral position of which might be accounted for by their presence in a diverticulum, or by the occupation of the left side of the bladder by something else, the presence of which seemed to be indicated by an ill-defined shadow (Fig. 369).

ON ADMISSION.—The patient stated that there was pain throughout the urethra during micturition, and straining to commence the stream, which was narrow, slow, dribbling, and vertical, the best position for micturition being one of forward bending. There had been no stoppage but the one mentioned. There was occasional slight pain in the penis after micturition, lasting

one hour, but not increased by walking or by the jolting of an omnibus. Micturition occurred every two hours, day and night. There had been shivering attacks after instrumentation, and bilateral backache for three months, but no headaches, nausea, or vomiting, or passage of stones. The patient stated that he had passed claret-coloured urine about once a fortnight for three months, the commencement of this period antedating the recent course of instrumentation, previously to which no instrument had been passed for years. The water, he said, had smelt bad for six weeks.

Appetite and digestion were good. the bowels costive, thirst was normal, the tongue clean and moist. The general condition was poor, the breathing laboured, and the chest barrel-shaped and moving 'en bloc'. There was retention of urine, with hypogastric percussion-dullness up to the navel.

A 10 (French) gum-elastic catheter was tied in, and brown urine with a faecal odour escaped. Further abdominal examination was negative, and rectal examination difficult because of a narrow anal canal and straining. The lower part of the prostate was reached, but no crepitus felt. The urine, of specific gravity 1020, was neutral, and contained pus, but no sugar.



FIG. 369.—Radiogram showing prostatic and vesical calculi and a vague shadow on the left of the bladder region.

OPERATION. —At the operation by Sir John Thomson-Walker on Jan. 11, 1926. the stricture was dilated with metal bougies from 6/8 to 9/11 (English); 10/12 would not pass. The bladder was opened, and two more or less oval smooth brown calculi were removed. Calculi were felt in the prostate, and an extensive inoperable growth on the left wall of the bladder. Much surface necrotic growth was removed, and the bladder washed out through a urethral catheter, which was afterwards tied in. Drainage was established both of the bladder and of the space of Retzius. The rate of respiration and of the pulse rose on the fifth day, the former being very rattling, and death, a merciful event, occurred on the ninth day from bronchopneumonia and cardiac failure.

END-RESULT OF A CASE OF FASCIAL URETHRAL GRAFT THIRTEEN YEARS AFTER OPERATION.

By R. J. WILLAN, M.V.O., NEWCASTLE-UPON-TYNE.

IN the BRITISH JOURNAL OF SURGERY, 1918, V, No. 19, I reported a case of "Fascial Grafting for the Repair of Traumatic Stricture of the Urethra". The stricture was behind the level of the deep layer of the triangular ligament; half-an-inch of scar tissue separated the torn ends of the urethra; and no

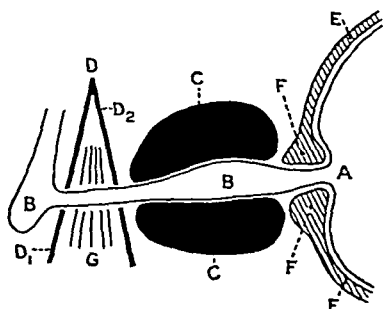


FIG. 370.—Showing the normal relations of the parts.

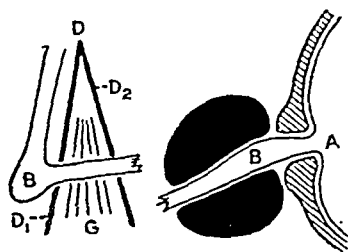


FIG. 372.—Showing the downward displacement of the proximal fragment.

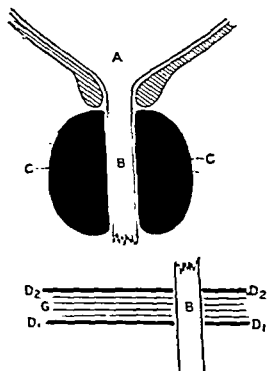


FIG. 371.—Showing the lateral separation of the torn ends.

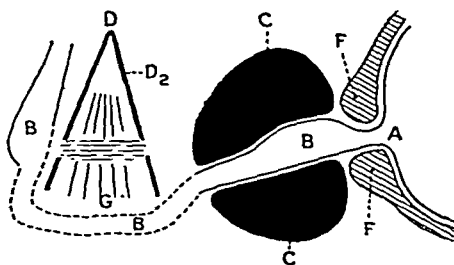


FIG. 373.—Showing the fascial graft (in dotted outline) uniting the penile and prostatic portions of the urethra. The membranous portion has been destroyed, and is replaced by fibrous tissue.

FIGS. 370-373.—DIAGRAMS OF THE PROSTATIC AND MEMBRANOUS URETHRA, ETC., ILLUSTRATING THE NORMAL RELATIONS OF THE PARTS AND THE CONDITIONS IN THE PRESENT CASE.

A, Bladder. B, Urethra. C, Prostate gland. D, Triangular ligament. D₁, Superficial layer of ligament; D₂, Deep layer. E, Bladder-wall muscle. F, Internal sphincter. G, Compressor urethrae.

instrument could be passed along the urethra into the bladder. The patient, then a man 32 years old, having acute retention of urine, was sent to me with a request that a permanent suprapubic fistula should be established.

The plastic operation on Feb. 5, 1913, consisted of: (1) Destruction of the membranous urethra; (2) Reconstruction of a new portion of urethra,

1½ in. long. A graft from the fascia lata was used, and it required to be carried round the lower margin of the triangular ligament.

On Aug. 7, 1914, a urethroscope showed: "Five inches from the external meatus, the lumen rather narrower than the portion in front; while, instead of being the straw colour of a normal part of the urethra, the new portion was white in colour, like scar tissue. Unlike scar tissue, however, this surface had a 'sheen' on it, due to a covering of epithelium".

I saw the patient at intervals, the last occasion being June 20, 1925, when I demonstrated the case on the occasion of the visit to Newcastle of members of the Interstate Post-graduate Assembly of America. The urinary stream was then a full, forceful one, and a dilating bougie, size No. 15 (English), was passed only at infrequent intervals.

In May, 1926, the patient died suddenly from a condition entirely unconnected with the urinary passage.

The operation can be regarded as a complete success, for the fascial graft amply served its purpose until the patient died, over thirteen years afterwards. Full details of the operation are given in the *BRITISH JOURNAL OF SURGERY*, 1918, V, p. 494. *Figs. 370-373* illustrate the normal anatomical relations of the parts concerned and the conditions in the present case.

EXCISION AND RESTORATION OF UPPER LIP.

By H. P. PICKERILL, NEW ZEALAND.

In a previous communication to the *BRITISH JOURNAL OF SURGERY*,¹ I showed a number of cases, chiefly military and therefore in young men, for whom considerable restorations of lost portions of the face had been undertaken by means of tube-grafts—including the double tube-graft flap, which I believe I originated in 1918. It may be of interest now to show the photographs of a civilian no longer young, for whom I did a similar type of restoration last year.



FIG. 374.—Large fungating growth of lip. History of old burn.

The patient, a man of 65, was admitted to the Dunedin Hospital with a large fungating growth of the upper lip about the size of a hen's egg (Fig. 374). He gave a history of having received a severe burn on the lip fifteen years ago. It had been slow in healing and had left a 'lump' on the inner surface of the lip; this 'lump' started getting larger about six months

ago and had grown rapidly during the last six weeks.

I excised the upper lip (*Fig. 375*) under local anaesthesia and sent the patient into the country for healing to take place and for observation as regards recovery.

The pathological report on the case was as follows: "The section of a piece of tissue from the lip shows a papillomatous type of growth with much more surface cornification than down-growth. The glands of the right and left sides show no evidence of malignancy. It is a slowly growing malignancy supervening on a squamous papilloma of the lip."

Six weeks later plastic restoration was commenced. The first stage was to form the new lip from two flaps, one from the chest for the inner surface

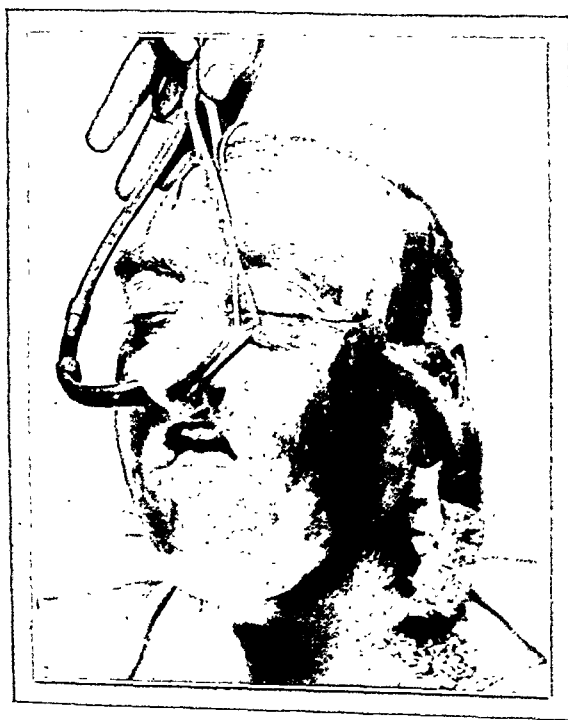


FIG. 375.—Lip excised. New lip formed by double tube-flap and ready for grafting. Photograph taken on operating table.

and one from the scalp for the outer surface. The scalp-flap is superimposed on the chest-flap, united, and allowed to lie alongside the left ear for a fortnight (*Fig. 375*). The lower end is then divided, swung across, and inserted in the prepared bed on the right and upper borders of the excision wound. At the next stage the graft is divided and the proximal end inserted into the left side of the excision wound. The scalp-tube is opened out and replaced. The patient, of course, was enabled rapidly to grow a moustache, with the result seen in *Fig. 376*.

The points of interest in this case are, first, the important fact that comparatively large grafts of this kind can be successfully undertaken for old

patients, a fact to which I have previously called attention. During the war it used to be suggested that grafting of this kind was all very well for soldiers who were young, fit, and not the subjects of any disease, but that such things would be extremely risky or impossible in old people, the subjects, say, of malignant lesions. My experience has been the opposite with regard to either free or pedicled skin-grafts; I am not referring to bone-, cartilage-, or muscle-grafts.

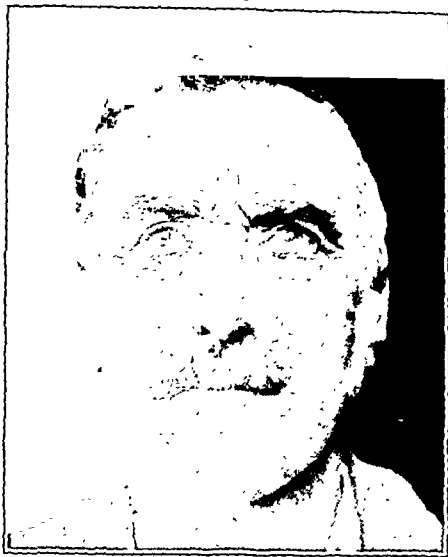


FIG. 376.—New lip grafted. Growth of new moustache unfortunately hides the pink lip-line referred to in the text.

The second point of interest lies in the excellent substitute chest-skin makes for mucous membrane when transferred in the manner described, i.e., by double tube-flaps. When I first started using this method at Sidecup during the war, I found it difficult to convince visiting surgeons that the pink, smooth tissue of the lip which they could see and feel was really skin and not mucous membrane, and when I showed this patient at a meeting of medical men recently I could detect the same scepticism. The extraordinary thing is that if the same skin were grafted into the same area as a free graft, it would be white and would remain white and would never take on the appearance of mucous membrane.

REFERENCE.

¹ *Brit. Jour. Surg.*, 1921, ix, 321.

AN UNUSUAL CASE OF CONGENITAL NÆVUS OF FOREFINGER AND THUMB.

By L. R. BRAITHWAITE, LEEDS.

A FARMER, age 43, had noticed during the last four years a wasting of the 'tissues' of his right hand, especially the forefinger and thumb. Latterly he had had pain at the tip of the forefinger, and three weeks ago some suppuration with a sanious discharge. He was thought to have a diseased terminal phalanx—possibly tuberculous, possibly an infection from an unnoticed septic wound.

Examination showed a condition well seen in *Fig. 377*. The backs of the hand, forefinger, and thumb showed a remarkable plexus of enormous veins; with the hand dependent these became more marked, and the tip of the forefinger and of the thumb throughout the length of the distal phalanges

became markedly blue and full; with the hand elevated, the same areas in finger and thumb became bright-red and flaccid, the skin falling into longitudinal creases.



FIG. 377.—Congenital naevus. Dorsal aspect.

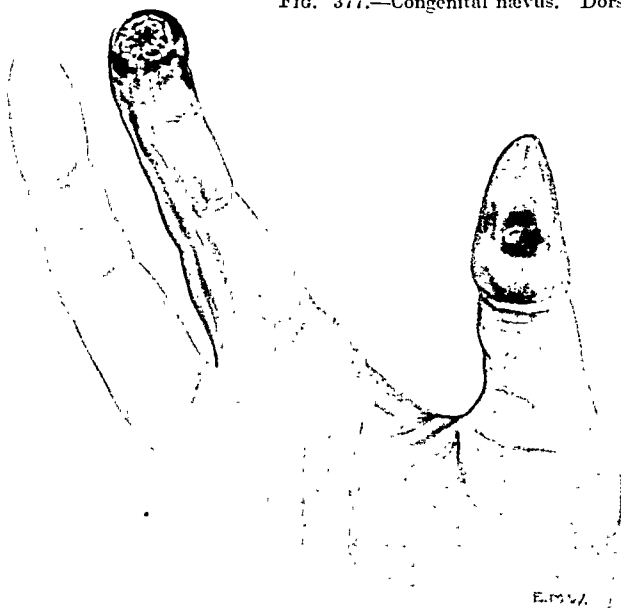


FIG. 378.—Congenital naevus. Palmar aspect.

The front of the tip of the forefinger showed an open ulcer with small areas of black necrotic tissue and old blood-clot; this area bled easily and very freely when irritated by slight injury, and was markedly tender to

touch. The palmar surface of the thumb showed an area of nævoid tissue edged in by a raised border (*Fig. 378*).

Owing to the persistent bleeding, pain, and discharge from the forefinger, an amputation of this finger through the middle of the second phalanx was performed. The operation was more vascular than usual, and healing did not easily occur, but eventually a very good result was obtained.

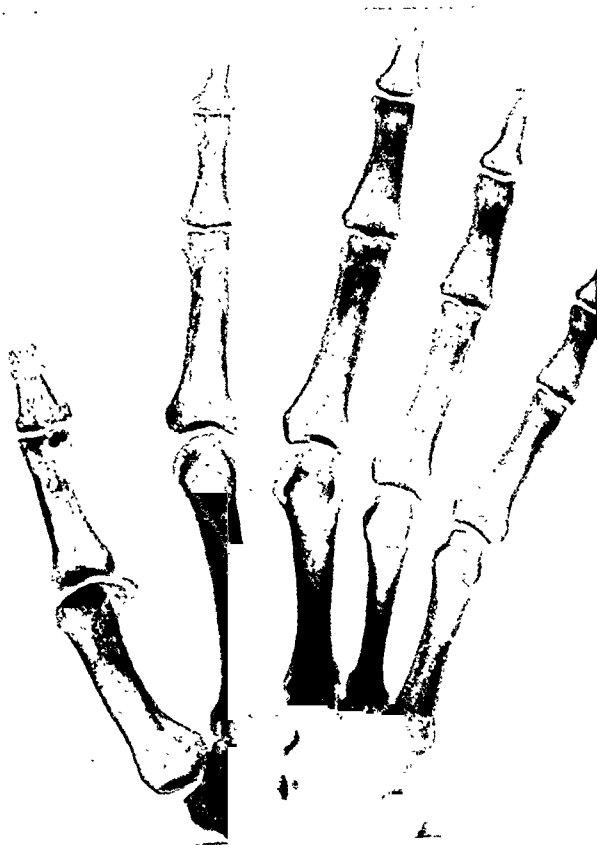


FIG. 379.—Radiogram showing congenital nævus of forefinger and thumb.

Inquiry into the history showed that the patient had the big veins on the back of the hand and the blueness in the finger and thumb all his life.

Examination of the amputated finger showed the soft tissues round about the ulcer to be built up of nævoid tissue. Sections of the phalanx showed enormous blood spaces throughout. These spaces and a rarefaction of bone affecting the thumb and the forefinger are very well seen in the accompanying X-ray photograph (*Fig. 379*), which was taken by Dr. Hinton Bateman, of York.

REVIEWS AND NOTICES OF BOOKS.

Surgery of Childhood. By JOHN FRASER, M.C., M.D., Ch.M., F.R.C.S., Regius Professor of Clinical Surgery in the University of Edinburgh; Consulting Surgeon to the Royal Hospital for Sick Children, Edinburgh. In two volumes. Medium 8vo. Pp. 1150, illustrated. 1926. London: Edward Arnold & Co. 42s. net for the two volumes.

THIS is a work of great erudition. It is the only book of significance dealing with the surgical diseases of children that has been published in Great Britain during the last half century, and for that reason alone it should be given a great welcome. Judged by the highest standard as befits its ancestry it leaves little to be desired; the defects of omission are more obvious than those of commission. The author has based his writings upon his own lectures to students—who must be supplied with the conventional answers expected by examiners—and he reveals himself in addition as an ardent student of embryology. There are two influences that tend to colour and to limit to some extent the scope of his writings. The problem of the care of disease from a biological, racial, or national standpoint is how to restore to Group A the Group A individual who has been stricken by an acquired lesion: from the same standpoints the fate of the *lusus naturæ* is of little significance, and an intensive study of its embryological failure as a prologue to the carrying out of patch-work surgery destined to achieve some unhappy survivals should not be indulged in at the expense of the former group. This slight lack of balance can be appreciated best by noting the amount of space devoted to résumés of stock embryological knowledge, illustrated by a quite superfluous number of pictures of dreadful 'freaks', and the number of acquired diseases that receive no mention in this book.

In the chapter headed, "Surgery of the Chest", there is no reference at all to the surgery of the pericardium, the anterior and posterior mediastina, foreign bodies in and abscesses of the lung, bronchiectasis, lung decortication for neglected empyemata, and the breasts. These last-named organs are not possessed apparently by children, and yet they frequently present problems of minor surgical importance. Amongst other omissions under the various systems must be noted ovarian and parovarian cysts and tumours, which present the clinical pictures either of symptomless mass formation or the acute crises of twisted pedicles—gonorrhœal pyosalpinx; mesenteric cysts (1 picture only) in their various aspects of symptomless cystic swellings, as causes of acute intestinal obstruction, or as the starting-point of acute intussusceptions, and providing formidable surgical problems; acute appendicitis in a hernial sac, and primary carcinomatous, sarcomatous, and streptothrix lesions of the appendix; encysted streptococcal abscesses of the peritoneum; permanent intussusceptions masquerading as abdominal tuberculosis; intussusception and Henoch's purpura occurring simultaneously in the same patient, which constitutes a grave surgical dilemma; and ureteric calculi. A calculus in the ureter on the right side is a well-known trap for the too facile diagnostician of 'chronic appendicitis'. No mention is made of large perinephritic abscesses, and a rather unhappy reference is made to alkaptonuria, which is devoid of all surgical significance, whilst cystinuria, with all that it implies to the patient if the surgeon fails to recognize or suspect that he has removed a cystin calculus from the kidney, ureter, or bladder, is ignored.

Stenosis of the urinary meatus—the commonest cause of retention of urine with overflow, the cause of meatal ulcer apart from an herpetic one, and the common reason when overlooked why the operation of circumcision is held in disrepute by

some of the laity—receives only obscure notice, whilst tuberculous peritonitis and pelvic sarcomata are omitted from the list of the causes of retention with overflow.

From the osseous system with its related structures the most noteworthy omissions are: malignant diseases of the upper and lower jaw; recurrent and non-recurrent fibromata of the nasopharynx; sternoclavicular joint diseases, with those of the related sternal epiphysis of the clavicle and acute osteomyelitis of the clavicle; our old friends 'pulled elbow' and 'clicking knees', the latter apparently *due to a* voluntary overaction of the popliteus muscle; and, above all, torticollis with fixed neck and flaccid muscles due to the many types of dislocation and fracture of the cervical vertebrae that children inflict upon themselves so readily. A full description of this form of torticollis might well replace the space devoted to the five quite unimportant theories about the origin of congenital wry-neck, and it should have been repeated again as a most important differential diagnosis from the early stages of tuberculous disease of the cervical vertebrae.

No fewer than sixty pages are devoted to the sterile tragedies of the surgery of congenital absence of the anal canal, of encephaloceles, spina bifida, and hydrocephalus; minor head injuries—and to a lesser extent major ones—might well have encroached upon much of this space, with reference to the writings of Horsley and Gavers so well epitomized in Crisp English's Hunterian lecture of twenty-five years ago. The pages on intracranial birth hæmorrhages need to be rewritten entirely in the light of Eardley Holland's report upon the subject to the Ministry of Health, 1922.

It is surely an oversight to state that acholuric jaundice has no surgical aspect (p. 866), as splenectomy has been practised with advantage in this country for fifteen years. Equally surprising is the omission of any reference to the use of radium in the treatment of papillomata of the larynx.

These omissions, however, only detract from the essential merits of the book inasmuch as the distinguished author's views upon these lesions are not yet available for the service of the community. The opening chapters upon general principles should be studied by everyone; and those clinicians who have practised for twenty years a rigid abstention from starvation and purgation as preliminaries to operative treatment, combined with a heaping up of the patients' reserves of O_2 carriers by the pre- and post-operative administration of glucose, will be refreshed to find their practice receiving the sanction of such an authoritative text-book.

Tuberculous and non-tuberculous diseases and injuries of bones and joints are dealt with in admirable detail which fills nearly the whole of Volume I. The lesson can be found permeating all the writings that nothing but the most meticulous attention to detail can be tolerated when surgical measures are used in the treatment of disease. The author's own operation of laminotomy for decompression of the spinal cord is most ingenious and worthy of an extensive trial.

In Volume II the chapters on the surgery of the abdomen should appeal to all readers; here they will relearn the necessity of applying in detail the general principles already expounded so lucidly in Volume I. The problems of hernia, glands in the neck, and deformities, both congenital and acquired, are set out at full length and clearly explained.

With regard to typographical errors, anomalies is spelt 'amanalies', p. 987, and throughout the book the name of Fairbank is misspelt consistently as 'Fairbanks'. In the addendum it might be noted that Pexuloid is the non-inflammable form of celluloid invented by Mr. T. W. Peck, F.C.S., in conjunction with the late Dr. F. E. Batten, when the latter invented his splints and casings for the treatment of palsies in children.

To sum up, the work is not encyclopædic, as might have been expected from its issue in two volumes, and the admirable clinical lessons contained therein are apt to be overshadowed in parts by descriptions of laboratory test-tube reactions of ephemeral value, of unimportant theories, and of recapitulations of embryology that ought to be taught and learned elsewhere. Nevertheless, it has assumed at once the position of the standard text-book upon the surgery of childhood, and there are no caretakers of the sick who can afford to be unfamiliar with its contents. It is a work of great expectations, of few disappointments, and of the brightest hope for many editions in the future.

Mesenteric Vascular Occlusion. By A. J. COKKINIS, M.B., B.S., F.R.C.S., Surgical Registrar, London Lock Hospital. Demy 8vo. Pp. 159 + xii, with 5 illustrations. 1926. London: Baillière, Tindall & Cox. 10s. 6d. net.

THIS thesis was prepared with the object of drawing attention to a subject which, in the opinion of the author has been "unjustly neglected in this country". It is based on certain anatomical researches and upon the clinical and post-mortem records of 76 cases in which occlusion of the mesenteric vessels had occurred.

The description of the anatomical arrangement of the mesenteric vessels is supplemented by an account of injection experiments carried out on the cadaver, which showed that occlusion only of the vasa recta or terminal arcades in the mesentery cut off the blood-supply of the gut. However, ligature of the main trunk below the origin of the middle colic artery cuts off the injection material from half the small intestine. It was found that there were weak spots in the collateral circulation at the upper and lower ends of the territory supplied by the superior mesenteric vessels.

As a result of disease the arteries or veins in the mesentery may be occluded, the former usually by embolism, the latter by thrombosis secondary to portal obstruction or sepsis in the portal area. An extreme degree of venous obstruction may take place without infarction of the gut.

The clinical manifestations are described, the picture being 'made up' from case records so as to give the 'typical' signs and symptoms which should indicate mesenteric occlusion. The picture presented is a clear one which should make the diagnosis relatively simple, yet a careful study of the author's 76 cases will show that this is not so in practice. It is argued that a carefully taken clinical history and a thorough examination "should in a large proportion of cases enable a correct diagnosis to be made". In the 76 cases the diagnosis was made and confirmed 6 times, and twice on apparently very slender foundations. It is possibly true, as the author suggests, that as the condition becomes better known the diagnosis may be made more frequently.

The treatment of the cases in which infarction of the gut has occurred is early excision of the affected portion. Out of 12 cases in this series in which this treatment was adopted 5 survived. When treatment was delayed death was inevitable—32 in the present series were operated on, resection was impossible, and they all died.

There are, however, many cases of complete obstruction of the portal vein without infarction of the gut; and so many of arterial embolism occurring in the course of a disease which is in itself inevitably fatal that we cannot share the author's optimism when he opines that "the time is not far distant when the prognosis of mesenteric occlusion will be considerably more hopeful than it has been in the past".

The House Surgeon's Vade-Mecum. By RUSSELL HOWARD, C.B.E., M.S. (Lond.), F.R.C.S. (Eng.), Member of Court of Examiners, Royal College of Surgeons, Surgeon to the London Hospital; and ALAN PERRY, M.B., M.S. (Lond.), F.R.C.S. (Eng.), Assistant Surgeon to the London Hospital. Second edition, revised and enlarged. Crown 8vo. Pp. 507 + viii, illustrated. 1926. London: Edward Arnold & Co. 12s. 6d. net.

THIS second edition is an enlargement of the first, and the authors have endeavoured to bring the book up to date by incorporating notes on modern methods used in the management of surgical cases. Such will be found especially in the sections dealing with the treatment of infected wounds, the treatment of shock, the researches into acute infections of the hand, the investigation of renal cases by pyeloradiography, and the treatment of fractures. The chapter on anæsthetics has been revised by Dr. Ashley Daly.

From the point of view of the house surgeon the chapters on inflammation of joints and those on fractures, with the details of after-treatment for special joints and special fractures, are perhaps the most useful in the book. Excellent photographs of patients under treatment by means of various splinting appliances form a noteworthy improvement in the description of fractures.

There are certain points which appear to call for further improvement in future editions. For example, the description of the technique of blood transfusion is bad, especially in that the method entails considerable manipulation of, and damage to, the donor's vein—a matter of no little importance so long as the 'voluntary system' of obtaining donors holds sway. In the account of skin-grafting it is stated that the area of skin from which the grafts are to be taken must "be prepared in the usual way for an aseptic operation" (with antiseptics). The chapter on amputations still contains a large number of operations which are never performed nowadays, and in describing Syme's amputation it is recommended that "drainage may be provided for by making a button-hole in the heel flap". It is doubtful, too, whether a house surgeon ever wants to know the five reasons for passing a catheter.

These points are, however, of small importance as compared with the vast amount of information the book contains. It must be admitted that a house surgeon who is left rather 'on his own' by his chief will not find all the direction he requires for the management of his cases before and after operation, but that is more than can be expected in a book of this size.

The Fundamentals of the Art of Surgery. By JOHN H. WATSON, M.B. B.S., F.R.C.S., Surgeon to the Victoria Hospital, Burnley. Demy 8vo. Pp. 349, illustrated. 1926. London: William Heinemann. 17s. 6d. net.

THERE are books on general surgery, books on special surgery, books on surgical technique, treatises dealing with emergency work, and manuals of minor surgery. The present volume cannot be placed in any of these categories. What claim it has for consideration—and it is a considerable claim—is based upon the appeal it makes to the man assuming the responsibilities of an actively surgical career, that he should take the widest possible view of his work. The author has this mission to carry out, and we think he succeeds. The fascination of technique, especially during the period of its acquisition, is apt to overshadow the other equally essential elements of the surgeon's art. The reader who digests the opening chapters of this book is not likely to fall into this error. This initial part is a collection of essays upon such subjects as the art of surgery, surgical efficiency, surgical judgement. They are pleasant reading, full of good advice and the wisdom of experience. The rest of the book is a miscellaneous collection of chapters upon the general conduct of operations and post-operative care. Much of this information can be obtained in a fuller and more systematic fashion in existing text-books, but here we get the recommendations, technical arrangements, and devices found to be the best in the practice of a busy surgeon in a large provincial town; therein lies its value. Though his customs may differ from those of the author, no surgeon can lay this book down without the feeling that he has acquired something of worth from its perusal.

A Handbook of Renal Surgery. By F. MCG. LOUGHNANE, F.R.C.S., Hon. Surgeon, St. Mary's Hospital, Plaistow; Hon. Assistant Surgeon, All Saints' Hospital for Genito-urinary Diseases. Demy 8vo. Pp. 210 + xiv, illustrated. 1926. London: Longmans, Green & Co., Ltd. 10s. 6d. net.

THE author states in his preface that "this book is intended for the use of general practitioners and students, and has been written with the aim of presenting in as concise a manner as possible a complete up-to-date statement of practical renal surgery". We congratulate the author, for he has produced what he set out to do; that the book is concise is shown by the fact that he has surveyed the field of kidney surgery in 210 pages, many of which are occupied by illustrations, and that it is up-to-date is proved by the large number of reproductions of pyclograms, most of which are excellent. So much attention is paid to the pathology and diagnosis of renal disease that the author has had to cut down the accounts of operative details to a minimum; perhaps he did this of malice aforethought, as

he did not consider students and practitioners to be fitted to grapple with operative details.

The defect of all such short and comprehensive text-books is that the author, in order to be concise, has to appear dogmatic. Several of the statements in this book are unusual, and one would very much like to read the experience that has led the author to make them; to quote just one: "In cases of enlarged prostate, where the blood-urea is high and indigo-carmin elimination delayed, the blood-urea returns to normal after a supra-pubic cystostomy long before the indigo test is satisfactory, but success in the second stage of the operation depends upon the obtaining of a satisfactory indigo test, rather than upon the return of the blood-urea to normal". This and numerous similar statements are given without being supported by any proof, and leave the reader incredulous.

The book is excellently printed and the illustrations are uniformly good: occasionally the English appears to us to be slovenly, as in the following statement: "The relations of the muscular surface are, viz. the transverse processes of the 12th dorsal", etc., where the 'viz.' seems to be superfluous; again, it is stated that the onset of pyelitis may be attended with 'low' rigors, and the reader is left puzzled as to what exactly is meant. There is, however, no doubt what the author means when he says that women are more liable to infection with the colon bacillus than men "owing to the semi-cloacal condition of their sexual anatomy"; but it does seem rather a horrid way of putting it.

The Secretion of the Urine. By ARTHUR R. CUSHNY, M.A., M.D., LL.D., F.R.S.
Second edition. Demy 8vo. Pp. 288 + xii, illustrated. 1926. London: Longmans, Green & Co. Ltd. 16s.

THIS book is one of the series of Monographs on Physiology, edited by Ernest H. Starling; its author was the late Professor of Pharmacology in the University of Edinburgh. As one would expect from the scientific eminence of the writer, the volume represents an earnest and most conscientious attempt to present the truth and to discriminate between what is fact and what is only theory—not an easy task, we fancy, in this particular subject.

The enormous amount of work involved in the composition of the book is shown by the bibliography of no fewer than 593 references; the author confesses that his "patience was sorely tried by some papers in which the depth bore no proportion to the length". Such a very large amount of information is compressed into the 288 pages of this monograph that the reader's attention has to be kept up to concert pitch to avoid missing the threads of the argument; but we are quite sure that the labour is not wasted, and that this will be a standard work on the subject for many years and will be invaluable as a work of reference.

It would need a physiologist to give an intelligent and sympathetic criticism of the author's long discussion on the various theories which are current on the mechanism of urinary secretion, but we gather that the late Professor Cushny was all for mechanical as against vitalistic explanations; it is no less certain that he found some serious stumbling-blocks in his attempt to eliminate the vitalistic element. Although much of the book is devoted to discussions of theories of urinary excretion which are of interest pre-eminently to the physiologist, there are numerous sections which will be of great interest to the surgeon, and we propose to refer to some of these.

On page 12 will be found an admirable summary of the voluminous literature on the subject of the influence of the renal nerves on secretion. Excellent sections are devoted to the excretion of dyes by the kidney and to the effects of complete and partial closure of the ureters. Of quite special importance is the statement that "when the blood is diluted by the intravenous injection of urea or salts, the kidney may continue to secrete though the blood-pressure is far below the point at which it would cease with normal composition of the blood"; this is encouraging in view of the occasional occurrence of anuria after prostatectomy. We should like also to draw attention to the remarks on the effect of closure of the renal artery

and on constriction and closure of the renal vein. The chapter on albuminuria and the excretion of bacteria by the kidney is full of interest to the surgeon. The last chapter is entitled "Notes on Nephritis and Other Renal Disorders" and contains a section on tests of renal efficiency; it is well worth reading carefully.

Altogether an admirable book which we can warmly commend to our readers.

Die Chirurgie: A System of Surgery. Edited by Professor KIRSCHNER (Königsberg) and PROFESSOR O. NORDMANN (Berlin). To be completed in six volumes. Fasc. 9, Vol. V. Imperial 8vo. Pp. 360, with 68 illustrations in the text and 39 coloured plates. 1926. Berlin: Urban & Schwarzenberg. M. 26.

THIS section of the big new German text-book on surgery is devoted to the abdomen, the abdominal wall, external hernia, peritoneum, and appendix.

Professor Müller, of Rostock, writes about the surgery of the abdominal wall. Anatomy, physiology, and development are described in some detail. Traumatic and inflammatory affections and new growths are dealt with before discussing the defects and their treatment. The utilization of the sartorius muscle to make good a defect of the rectus abdominis is described and figured. The chapter terminates with a consideration of the plastic surgery of pendulous belly.

The chapter on external hernias is by Dr. Eggers, of Rostock. Various theories of the origin of hernias are mentioned, without definite adhesion to one. Very clear diagrams and coloured figures illustrate the different types of hernia, and the complications of taxis. Bassini's operation is well described, and the chief modifications are mentioned, but one looks in vain for special discussion of the treatment of direct inguinal hernias, or for any mention of the use of filigrees or of fascial grafting. The unusual forms of hernia are fully described. The mention of trusses is very brief and unaccompanied by any illustrations, nor is there any reference to the varieties of trusses suitable for special types of hernia.

Dr. J. Petermann, of Berlin, gives the chapter on the peritoneum and omentum, and his general description of peritonitis, with the clear illustrations and extensive literature references, affords an excellent exposition of the subject.

The concluding chapter of this section is devoted to the appendix and its diseases, and is by Professors Läwen and Burckhardt, of Marburg. The gross and minute anatomy are well described and illustrated. In the section on the etiology of appendicitis one is disappointed to find that it is assumed that the disease has always existed, and that there is practically no discussion on the mysterious prevalence and increase of the condition since the beginning of the present century. The clinical aspect of the subject is very carefully and accurately described and the coloured figures of pathological conditions are of high artistic merit. The discussion of the so-called chronic appendicitis and its differentiation from other causes of abdominal pain is especially valuable. In dealing with the rarer diseases of the appendix, the incidence of parasitic infection is perhaps unduly stressed, whilst that of actinomycosis hardly receives the attention or illustration that its importance deserves.

Die Chirurgie: A System of Surgery. Edited by Professors KIRSCHNER and NORDMANN. Fasc. 10, Vol. V. Imperial 8vo. Pp. 319, with 91 partly coloured illustrations in the text and 10 coloured plates. 1926. Berlin: Urban & Schwarzenberg. M. 21.

THIS section deals exclusively with diseases of the stomach and duodenum. It is written by Professors Guleke, Niden, and Smidt from Jena, and, although illustrated by a number of excellent coloured figures, it is somewhat disappointing in its rather partial and uneven treatment of the subject. The first portion of the monograph deals with general principles, anatomy, physiology, methods of examination, and operative technique. Of this, the description of the X-ray appearances of the normal and diseased organs is full and valuable, but the chemical examination is very meagre and not worthy of any classical book of reference. All the standard operations are well described and illustrated, but the description is rather that of formal procedures which might be carried out in the dissecting-room than of actual operations on diseased tissues.

The chapters dealing with ulcer and cancer are the best in the monograph. Possibly the diagnosis of gastric ulcer might be more fully discussed, especially in relation to functional conditions such as visceroptosis. But the descriptions of symptoms, complications, and treatment are full, clear, and beautifully illustrated. Our main criticism of this part is that the affections of the duodenum are not sufficiently differentiated from those of the stomach.

Die Chirurgie: A System of Surgery. Edited by Professors KIRSCHNER and NORDMANN. Fasc. 11, Vol. V. Imperial 8vo. Pp. 163, with 77 illustrations, some coloured, in the text and 7 coloured plates. 1926. Berlin: Urban & Schwarzenberg. M. 10.

This section is concerned only with the rectum and anus, and is written by Professor Tietze, of Breslau, and Dr. Reichle, of Stuttgart. It opens with a clear and well illustrated account of the anatomy of the parts and the various congenital malformations. Prolapse of the rectum is fully described and discussed, and a variety of operations are given in detail. Inflammatory affections, and simple and specific ulcers are fully dealt with, but the descriptions of the different varieties of fistula occupy only a small space with a single figure in addition to two coloured microscopical sections.

The section on hæmorrhoids is very much on ordinary lines, ligature and excision being described as the routine method of treatment, whilst injection methods and Whitehead's operation are also mentioned. Malignant disease forms the subject of the last part of the monograph. The sacral method of excision chiefly associated with Kraske's name is described at some length as the routine radical operation. The abdomino-perineal method, though mentioned, is not given the importance which it deserves, nor is it illustrated.

Die Chirurgie: A System of Surgery. Edited by Professors KIRSCHNER and NORDMANN. Fasc. 8, Vol. IV. *Die Chirurgie des Ohres.* By Professor Dr. ARTHUR BLOHNKE. Imperial 8vo. Pp. 277, with 75 illustrations in the text and 4 coloured plates. Berlin: Urban & Schwarzenberg. M. 16.

This eighth part of the fourth volume of the series deals with the surgery of the ear. Professor Blohnke does not depart from the usually accepted arrangement; he deals first with the anatomy, physiology, and histology of the subject in an exceedingly lucid manner. There are no unnecessary details to leave a confused impression on the mind; throughout there is never a suggestion of padding.

The author recommends the rough and ready caloric reaction of Brühl. We have found that of Kobrak more useful and delicate, particularly when the difference between the two labyrinths is slight. The author goes into some detail about local anaesthesia in ear operations, but is not enthusiastic, a viewpoint which possibly is shared by his colleagues in this country. He nevertheless favours Von Eicken's method of inducing local anaesthesia of the external auditory meatus for furunculosis. The descriptions of the actual operations are unusually clear and in a class by themselves. These are no mere transcriptions from a previous text-book, but obviously the result of the rich experience of an exceedingly practical man. An admirable discretion is shown in the selection of operative methods: from the staggering number of operations for eversion of the auricle only two are selected—those of Gersung and Passow. One cannot but agree with the author when he says that Cushing's operation for eighth-nerve or cerebellopontine-angle tumours has put all other methods "completely in the shade". He omits describing other methods. The hints of how to find the antrum in a sclerotic mastoid are exceedingly valuable. He recommends the approach from above downwards, even to exposing a small portion of the dura mater of the middle fossa as a guide. The radical, the Schwartz, and the labyrinthine operation of Neumann Janson receive adequate treatment from the practical point of view. It is unfortunate that the operation which may entirely replace the Schwartz, and also to a certain extent the radical, and which has particular regard to the saving of hearing, is entirely omitted—I refer to the conservative operation of Heath. The book concludes with a detailed section of the intracranial complications and their treatment.

We do not recollect reading a text-book with more pleasure or profit. It seems

a pity that otologists are forced to buy the whole of the six volumes in order to obtain this one book—the publishers state quite definitely, however, that it is not available separately. There is no index. We are told a collective index will be issued with the last volume of the series. Professor Blohmke is to be congratulated on having produced a comprehensive work that is not ponderous, indeed a *rara avis* with our German colleagues. With a little more generosity in the way of illustrations—there are only 79—and provided it is obtainable separately with an index, it should take its place among the books of reference in operative otology.

Lehrbuch der topographischen Anatomie. By JOHN BLUMBERG, Lecturer in Surgical Anatomy at the University of Dorpat in Esthonia. Royal 8vo. Pp. 486, with 152 illustrations, most of which are in colour. 1926. Berlin and Vienna: Urban & Schwarzenberg. M. 21; bound, M. 24.

THIS is without doubt one of the finest works on the subject of regional anatomy that has been published in recent years. The text is full, clear, and accurate, whilst the numerous large illustrations are models of artistic skill and anatomical accuracy. A very large number of these figures are taken from unusual points of view or from special dissections, and in this way show up the relationships of the various structures in a striking manner. The book is divided into eight chapters, which deal with the chest, abdomen, pelvis, back, lower extremity, head, neck, and upper extremity.

We have not been able to find any inaccuracies in text or figures, but a curious want of proportion occurs in several of the arm illustrations (Figs. 137, 144, 145), in which the ulnar collateral artery (or, as we should call it, the inferior profunda) is depicted as being of almost the same size as the lower part of the main brachial artery.

We certainly should welcome an English translation of this work if it were only for the sake of the beautiful figures.

Die operative Technik des Tierexperimentes. By H. F. O. HABERLAND, Professor of Surgery in Cologne University. Royal 8vo. Pp. 336, with 300 illustrations. Berlin: Julius Springer. M. 28.50; bound, M. 30.

THE worker who is commencing an experimental study in the laboratory is faced immediately by many problems connected with the anatomy, mode of handling, anæsthetizing, and care of the animals with which he proposes to work. As a rule he must serve an apprenticeship in laboratory technique before he can proceed to any fruitful piece of research. Professor Haberland has performed a useful service in outlining in concise form the essentials of the anatomy and the methods of handling the various animals employed in the experimental laboratory, and in giving a brief but comprehensive résumé of the operative methods employed in investigations on the various systems of the body. The methods described are simple and in some cases even crude, and are designed to allow of experimental work with the minimum of assistance.

Whilst much recent experimental work is not even referred to and the methods employed in other countries are largely ignored, the author has made a distinct contribution to experimental surgery. All laboratory workers will find some useful hints by reference to this work, which is commendably concise, and freely and well illustrated.

La Pratique chirurgicale illustrée. By VICTOR PAUCHET. Fasc. 9. Royal 8vo. Pp. 260, with 246 illustrations by S. DUPRET. 1926. Paris: Gaston Doin et Cie. Fr. 40. [7s. 6d.]

WHEN completed Victor Pauchet's book on operative surgery will comprise twenty volumes. In the ninth volume, which is now under review, Pauchet returns to his favourite subject—duodenal ulcer—and as in previous volumes the numerous and lucid illustrations of Monsieur S. Dupret render the text almost superfluous. Gastrectomy after failure to cure with gastro-enterostomy and gastro-jejuno-colic fistula

are especially considered. Resection *en masse* of the distal half of the stomach with the proximal half of the colon and a portion of the jejunum is advocated for the latter condition. No fewer than three anastomoses are involved in this method, together with the establishment of a temporary fistula for the terminal ileum and the distal colon—a truly heroic procedure.

A method of abdomino-perineal excision of the rectum with preservation of the sphincters is described. This is the operation which was employed for a short time some twenty years ago in London and styled 'abdomino-anal'; it was abandoned in favour of the abdomino-perineal operation with colostomy. Some disadvantages of the method Pauchet describes may be cited: It is less radical as regards the lymphatics; it often results in poor control; and there is considerable danger of sloughing of the lower end of the colon from deficient blood-supply. The abdomino-perineal operation with colostomy is also described. Pauchet carries out the perineal stage by dissecting from below upward instead of from above downwards. The latter method is usually adopted in this country and is certainly quicker. The closure of faecal and biliary fistulae and anterior nephrectomy are well described.

Operations for hallux valgus and great mammary hypertrophy (by Pierre Mornard) are included in the volume. For the latter condition an ingenious, if somewhat elaborate, method of mastopexy is described. If it can be carried out with success in lieu of amputation, it will be welcomed by all surgeons.

Throughout the volume every operative stage is clearly portrayed, a most valuable asset in any work on operative surgery.

Traitement des Cancers du Maxillaire inférieur. By Dr. RAYMOND BERNARD, ancien interne des Hôpitaux de Paris. Pp. 116. 1926. Paris: Gaston Doin. Fr. 18.

This is a monograph on cancers of the tongue, floor of the mouth, cheek, or tonsil, which extend to and invade the lower jaw. It is a grouping of cases which is justified from the fact that the osseous lesion dominates the situation. An account of the clinical features and pathology is given first, and stress is laid upon the fact that extension through the inferior maxilla is very slow, especially in the lower dense part of the jaw, so that since invasion takes place from the gum, it is nearly always permissible to retain the inferior margin of the mandible. Successively, treatment by radium, radium combined with surgery, and surgery alone are given. Treatment by radium alone is condemned because of the sepsis which results from the inevitable necrosis of bone, and the outcome of the combined method is little better. Much more satisfactory results have been obtained by pure surgical measures. Though the mortality is very high (43 per cent), yet amongst the survivors 43 per cent remain cured permanently. The author believes in an extensive operation for the removal of the lymphatic glands in the neck, and recommends removal of the sternomastoid with a clearing of both posterior and anterior triangles.

L'Arthroplastie du Genou. By Dr. C. H. CHEVALLIER, Faculty of Medicine of Paris. Royal 8vo. Pp. 152, with 7 plates. 1926. Paris: Masson et Cie. 2s. net.

This little monograph should be read by all general surgeons. As many as 444 cases have been recorded, with a large number of failures, but amongst them there stand out Professor Putti's 63 operations with only 1 death, 4 failures, 5 poor results, and 52 successes (83.87 per cent) giving a mean mobility of 57°. If one surgeon by proper selection of cases—the average age is 26 years, and no tuberculous cases are included—and by a well-developed technique can obtain such results, the operation deserves, as the author says, to enter into surgical practice. The procedure here described and figured varies but little from that of Putti: the essence of it is the transplantation of one very long wide strip of fascia lata, which gives continuous covering to the bone ends, the soft parts at the back of the 'joint', the posterior aspect of the patella, and the lengthened quadriceps expansion. The technique is

not difficult; the graft lives well and controls the formation of new bone. Difficulties may arise from blood-oozing after closure of the soft parts and removal of the tourniquet. If this trouble be surmounted, a new membrane of capsule type forms about the bone-ends, and it is stated that the new joint is less susceptible to blood-borne infections than a normal articulation.

Technique des Prélèvements et des Biopsies dans la Pratique clinique. By ROBERT DUPONT, ROGER LEROUX, and JEAN DALSACE. Crown 8vo. Pp. 142, with 50 illustrations. 1926. Paris: Masson et Cie. 2s.

THIS small book is intended to give precise directions for the obtaining and preparation of material from the patient for pathological examination and report. It includes examination of the blood, urine, cerebrospinal fluid, gastric contents, stools, milk, spermatic fluid, pus and serous fluids, and morbid tissues. It is very concise and practical, and illustrated by clear line drawings.

Chirurgie de L'Estomac. By HENRI HARTMANN, Professeur de Clinique chirurgicale, Chirurgien de l'Hôtel-Dieu; with the collaboration of NICOLAE BARBILIAN, R. BENSAÛDE, CHABRUT-ASTAIX, DE POLIAKOFF, and ROBERT TARJAN. Part I. Imperial 8vo. Pp. 336, with 115 illustrations. 1926. Paris: Masson et Cie. 6s. 8d.

PROFESSOR HARTMANN has written a book which will become a work of reference, and is particularly valuable as it is a faithful record of the experiences of a master surgeon, extending over many years. This part treats of methods of examination of the stomach, perforated ulcers of the stomach and duodenum, the technique of operations upon the stomach, gastrojejunostomy in all its aspects, the results of operations upon cancer of the stomach, the changes in the gastric chemistry brought about by operations on the stomach, gastrojejunal ulcer, and benign new growths. Its pages are full of interest to anybody engaged in this branch of surgical work, and all subjects have been discussed with admirable judgement. Professor Hartmann has employed the gastroscope, and he uses one of his own pattern which is passed over a wire guide. He thinks gastroscopy has a definite place, but it should be the last method of examination before resorting to a laparotomy, which it will sometimes obviate. He believes that it will have a great future.

The section on perforated ulcers is very complete and contains most useful information. For instance, we learn that the cures after draining a perigastric abscess resulting from a perforated ulcer amount to 42·8 per cent. This is a very grave condition, but these figures show an unexpected recovery-rate. On the question of shock in perforation about which there is some discussion, the author states that cases occur which die in a few hours from shock alone. He admits they are rare, but maintains that they exist. He does not believe it is wise to wait for the stage of shock to pass off, however, before operating. His recommendation is to operate as early as possible, as it is important to prevent infection of the peritoneal cavity. The mortality in perforated ulcer, according to his statistics, was 29 per cent for fourteen years, but only 15 per cent for the last fifteen years. He stresses the importance of early intervention. He discusses the question of gastrectomy for perforated ulcer, and concludes that it has twice as great a mortality as simple suture alone or suture combined with gastro-enterostomy, of which the mortalities are the same. Only 10 per cent of patients who have had simple suture required a subsequent gastrojejunostomy. He thinks the end-results of gastro-enterostomy plus suture are uniformly good. The late results, however, seem to depend to some extent on the nature of the ulcer, whether it was an acute or chronic lesion.

In the section on technique all operative methods are fully discussed, including such rare operations as resection of the cardia and total excision of the stomach. Excision of the lesser curvature combined with gastro-enterostomy has given good results. The author has never seen suppuration or bad result follow the removal of a slice of the pancreas in performing gastrectomy for carcinoma. The mechanics

and physiology of gastro-enterostomy are well set forth, and an account is included of the author's investigations into the influence of the situation of the anastomotic opening upon the path of exit of the chyme.

As many as 843 gastro-enterostomies are reported which were operated upon by Professor Hartmann and his associates. The mortality was 26 per cent in cancer cases and 10 per cent when the operation was done for benign affections; 2.5 per cent of the deaths were due to lung complications in ulcer and 5 per cent in cancer. There are reports of the other complications which have occurred and a discussion on the treatment of them.

In recording the results of gastrojejunostomy for ulcer Professor Hartmann has been surprised to find how well the ulcers of the lesser curvature have done with this simple operation. In the account of gastrojejunal ulcer he states that the ideal operation for its cure is to undo the anastomosis, resect the stomach, and finish by a terminal junction. The section on cancer of the stomach, where 100 cases are reviewed, gives a surprising recovery-rate of 30 per cent well after three years.

This book can be recommended to all abdominal surgeons, for it seems to be a very fair statement of the surgery in competent hands.

La Cystographie: Etude radiologique de la Vessie normale et pathologique. By Drs. H. BLANC and M. NEGRO. Royal 8vo. Pp. 192, with 108 illustrations. 1926. Paris: Masson et Cie. 6s. 8d. net.

THIS monograph gives a full and satisfactory account of cystography, which may be defined as the study of the bladder by taking X-ray photographs of the organ after it has been filled with a solution opaque to the X rays.

The authors have carried out the extensive investigations which formed the basis of this work in the Service Civile of the Lariboisière Hospital; the preface has been written by Dr. G. Marion, the head of the department. They begin by giving a short history of cystography and a full description of the technique which they have adopted; we note that they come to the conclusion that the most convenient medium for distending the bladder is sodium bromide, which they use in strengths never exceeding 10 per cent. Numerous diagrams are given to show the position of the patient and of the X-ray tubes.

After devoting some time to the discussion of photographs illustrating the normal bladder in its various degrees of distention, the authors show a wonderful series of photographs of diverticula of the bladder; they think that cystography is of great importance in this condition. Numerous prints of cystographs of cases of tumour of the bladder indicate what a considerable aid these may be when the vesical cavity is so encroached on that cystoscopy is extremely difficult. A most interesting chapter is that devoted to patency of the ureteral orifices, and another equally interesting section is that in which illustrations of congenital abnormalities are given.

The results of cystography in the diagnosis of enlargement of the prostate are frankly disappointing, as the authors indeed point out. Pneumocystography is discussed, but the authors do not favour this method of investigation.

The skiagrams are beautifully reproduced, and we have no hesitation in recommending this book to our readers, especially to those who are interested in urinary surgery.

Chirurgie du Sympathique: Chirurgie du Tonus musculaire. By P. WERTHEIMER and A. BONNIOT, with a Preface by Dr. LERICHE. Royal 8vo. Pp. 135, with 21 illustrations. 1926. Paris: Masson et Cie. Fr. 22.

A BELATED contribution to the overburdened subject of sympathetic ramiscation for spastic states. The authors commence by a consideration of the anatomy of the sympathetic system, beautifully illustrated by original plates. The physiology of muscle tone and the rôle of the sympathetic is then outlined. The authors frankly avoid the main issues of controversy in the theoretical and experimental aspects,

but prefer to take their stand by the results obtained after operation in diseases characterized by spasticity.

After a detailed consideration of the operative technique for cervical and lumbar ramisection, the authors quote detailed results from a case of Adson's, two of Brunings's, and seven of their own. They emphasize the innocuousness of the operation (89 ramisections without a death) and the absence of ill-effects such as wasting of muscles or visceral disorders. A degree of ptosis and enophthalmos is usual after division of the cervical sympathetic, but is transitory; reference is also made to the appearance of flushing over the corresponding limb. The effect on muscle tonus has been inconstant and slight; in general terms, rigidity due to vascular lesions and to spinal sclerosis is less amenable than when resulting from cortical injury or birth palsies. The authors repeatedly state that the applicability of this operation is still *sub judice*, and that time alone will delimit its sphere of usefulness.

In detailing the clinical condition before and after operation the conclusions are severely invalidated by incomplete neurological investigations. The quantitative estimation of hypertonus is still unsatisfactory, and inaccurate mechanical measurement of the degree of spasticity can only be compensated by the most painstaking examination of the central nervous system by competent authorities at repeated sittings. Such data are wanting in the cases reported by Wertheimer and Bonniot. Another important point which must be borne in mind is the prematurity of the post-operative publications; not one of the authors' cases was reported upon at a period longer than thirteen weeks after the operation. In view of the acknowledged transitory nature of the Claud-Bernard-Horner syndrome after cervical ramisection, there is no reason for expecting the occasional slight diminution in tonus to be other than temporary. It is possible that the vasomotor instability immediately following section of the sympathetic is in part responsible for an increased suppleness in the corresponding limbs, but here again permanent results are scarcely to be expected. Lastly, the psychology of the patient must also be realized, and one must be scrupulous in ruling out mere removal of functional disability which had been engrafted upon a genuine organic substratum in cases of chronic nervous disease.

The volume concludes with a bibliography, in which one or two important monographs do not appear.

Handbook of Diseases of the Rectum. By LOUIS J. HIRSCHMAN, M.D., F.A.C.S.
Fourth edition, revised and rewritten. Medium 8vo. Pp. 403, with 232 illustrations and 5 coloured plates. 1926. London: Henry Kimpton. 30s. net.

It speaks highly for the popularity of this book that it has reached a fourth edition since its publication in 1909.

The opening chapter contains a concise account of the essential anatomy of the parts concerned. When speaking of the lymphatic system of the rectum there is some ambiguity in the description of the lymphatic glands situated between the rectum and the sacrum, which the author refers to as the postrectal glands. So far as we are aware there are two distinct sets of glands in this locality—namely, the glands contained in the terminal portion of the pelvic colon (commonly called retrorectal glands), which are invariably involved in cancer of the rectum, and the presacral glands, situated along the course of the lateral sacral vessels, which are involved during the later stages of that disease and only when the growth has extended beyond the limits of the fascia propria. Since both these glandular groups are found between the rectum and the sacrum it is important that a distinction should be made between them.

Chapter 2 deals with symptomatology. The author gives very sound advice when he says that rectal hæmorrhage, no matter how slight, should never be taken for granted as diagnostic of hæmorrhoids or any other disease, but should call for a complete examination. Chapter 3 is devoted to a description of the various methods employed when making an examination of the patient. Anoscopy, proctoscopy, and sigmoidoscopy are all carefully described, and many useful hints with

regard to the use of the instruments are given. Chapter 4 deals extensively with local anaesthesia and sacral anaesthesia. The technique of these procedures is carefully described. When speaking of sacral anaesthesia no mention is made, however, of the advisability of making sure that the theca has not been penetrated by the needle before introducing the solution into the sacral canal. Chapter 5 discusses the limitations of local anaesthesia and the general contra-indications to its use.

Constipation and obstipation are dealt with at considerable length in Chapter 6, etiological factors being discussed and various methods of treatment described. Among the latter is the author's method of direct stimulation of the atonic sigmoid and rectum by means of mechanical dilatation. For this purpose he makes use of a specially-shaped rubber bag provided with a stem which is slipped over the distal end of a Wales's bougie. Compressed air of low pressure is allowed to enter the bag, thus slowly producing distention to any required extent. The author's operation for rectal valvotomy is also given in detail.

Chapter 8 is concerned with that peculiarly distressing complaint *pruritus ani*. The possible etiology is fully discussed and the various operative procedures that have been suggested from time to time as curative receive careful consideration. The author's technique for his modification of Ball's operation is described in detail. Anal fissure and ulcer are fully considered in Chapter 9. As one of the causes of fissure the author mentions the tearing-down of an anal valve. We do not agree with this, as we consider that a true fissure and a torn-down anal valve are totally distinct things, as evidenced by their shape; the fissure being pear-shaped, whereas the margins of the lesion produced by a torn-down valve are parallel to one another. When discussing surgical treatment preference is given to excision over the much more simple expedient of incision.

The various abscesses met with in the ano-rectal region are described in Chapter 10 and the method of operating applicable to each is given in detail.

Chapter 11 is devoted to the subject of fistula, but this is unfortunately incomplete because only those varieties that are amenable to treatment under local anaesthesia are discussed. The classification of fistulae is the one usually adopted, and is, in our opinion, insufficient, as it presumes that all fistulae are of the same type. The author quite correctly states that the type of a fistula depends upon the location of the abscess which preceded it, but he does not carry this observation into effect when he classifies them. We consider that the failure to realize that fistulae differ greatly in type is the principal cause of the disastrous effects of operative interference in some cases.

Hæmorrhoids are discussed in Chapter 12, the various operative procedures that are usually employed being set forth in detail. The remainder of the book does not call for much comment, and is concerned with polyposis, dysentery, and prolapse. We are surprised to find that the important subject of cancer is dismissed in a cursory notice in the chapter on local anaesthesia. The pathology of the spread of cancer from the rectum is not even mentioned, nor are the operative measures referred to that have been devised with a view to the complete eradication of the disease. We consider that this is a grave omission in a work that purports to be a guide to the treatment of diseases of the rectum.

What it Feels Like: Letters from a Doctor out East to a Colleague at Home. By 'DR. ROBIN', M.A. (Oxon), M.R.C.P. (Lond.). With an Introduction by Sir HUMPHREY ROLLESTON, Past President of the Royal College of Physicians. Crown 8vo. Pp. 78. Paper covers. 1926. Student Christian Movement. 2s. net.

THIS little collection of letters from a medical missionary in China to a friend in England purports to answer the question, so often asked concerning missionary life: "What does it feel like to be a missionary?" The author, who calls himself Dr. Robin, and who studied at Oxford under Sir William Osler, answers this question in a manner so enthusiastic that to the average reader it may seem a little exuberant. Despite his obviously sincere devotion to a noble cause, it is difficult to feel that he has not somewhat overworked such adjectives as 'wonderful' and 'fascinating'.

The book contains, however, much that is interesting, notably the description of a morning among Chinese out-patients, and the accounts of work in famine and war areas. Dr. Robin is clearly a keen admirer of Chinese character and especially of the Christian Chinese medical student. The reader will probably conclude after reading these letters that the medical missionary has really very little time to feel at all, so multifarious are his activities and so wide is his sphere of service. What he cannot fail to realize is that this work is indeed, as Dr. Robin says, "a worth while job".

The familiar style, due to the epistolary form, is bright and racy, although there are a few expressions, such as "Med. Mish." (medical missionary) which must offend the ear of the reader with any pretension to literary taste.

On the whole, Dr. Robin provides food for some stimulating thought; his enthusiasm is refreshing and he has much to say which is well worth hearing; though we think, if he will allow us to say so, that a slightly more restrained treatment would have made his message more convincing and given to it a much wider appeal.

The Crippled Hand and Arm. By CARL BECK, M.D. Medium 8vo. Pp. 243 + xi, with 302 illustrations. 1925. London: J. B. Lippincott Co. 30s. net.

THIS work deals with deformities of disease, injuries, and congenital defects. The opening chapters on anatomy and physiology do not call for any special comment, except that we do not think there is an adequate description of the fascial spaces with which Kanavel's work has made us familiar. The section on congenital deformities has a large number and variety of conditions described, but we think that so well recognized a deformity as that of Madelung ought to have found a place, whereas this condition is only briefly mentioned; and that under the title of club-hand the deformity called the Strahlen defect should have been noticed.

The chapter on wounds and injuries is chiefly composed of an account of personally observed cases, and we note an ingenious method of substituting a toe nail for a lost finger nail. The remainder of the book deals with disorders of the wrist, elbow, and upper arm, but in most subjects the description of methods of treatment is not full or clear enough to be of much value. For example, the all-important subject of the technique of the transplantation of tendons and bone is dismissed in three pages at the end of the book.

The volume contains a great deal that is of value, but its incompleteness and inequalities tend to prevent its accomplishing the object with which it was written.

A Classification of the Tumours of the Glioma Group on a Histogenetic Basis, with a Correlated Study of Prognosis. By PERCIVAL BAILEY and HARVEY CUSHING. Medium 8vo. Pp. 175, with 108 illustrations. 1926. Philadelphia, London, and Montreal: J. B. Lippincott Company. 21s. net.

THIS monograph represents an attempt to correlate the structural differences of the cerebral gliomata with the well-known differences in clinical behaviour which exist amongst the tumours forming this, the largest, group of cerebral neoplasms.

Histological study of 400 gliomata by special staining methods has resulted in the differentiation of fourteen varieties according to the similarity of the predominant tumour cell to some stage in the differentiation of the cells arising from the neural groove. The relative degrees of malignancy, according to the average survival period from the date of the earliest known symptoms, are set out in a table. By this criterion the tumours range from the 'medullo-epithelioma', with an average survival period of ten months, to the 'astrocytoma fibrillare', with an average survival period of more than eighty-nine months. The most malignant tumours are those which reproduce the structure of the less differentiated cells in the developing central nervous system, whilst the more nearly they reproduce fully differentiated cell types, the more slowly do they grow and the less tendency do they exhibit to recur after removal.

The work constitutes an important addition to our scanty knowledge of the

nature and habits of the gliomata, and whilst naturally far from complete, it contains facts and suggestions which should be of great value to the surgeon who is called upon to deal with neoplasms of this kind, both as regards prognosis and as a guide to the extent of the operative measures to be pursued. The value of the book is increased by an excellent bibliography.

The Treatment of Fractures; With Notes upon a Few Common Dislocations. By CHARLES LOCKE SCUDDER, A.B., Ph.B., M.D., F.A.C.S., Consulting Surgeon to Massachusetts General Hospital. Tenth edition. Royal 8vo. Pp. 1240, with 2027 illustrations. London and Philadelphia: W. B. Saunders Co. 55s. net.

THIS has now undoubtedly become the standard book on the subject in the English language. It certainly has no rival in the matter of completeness. The present edition is a considerable enlargement of the work and presents several new features. Of these the most notable are articles by special authors—namely, on pathological fractures by Bloodgood, bone repair by Bancroft, the maxilla and mandible by Thoma, massage by Mennell, anaesthesia by Richardson, and birth fractures by Truesdell.

It is difficult in the space at our disposal to do justice to this book. It really forms a reliable encyclopædia on the subject and it includes practically everything of importance which one may need to know. The new sections, especially those on pathological fracture and on bone repair, are of great value. Fractures of each region are first described systematically and the general lines of treatment for each variety are laid down. Special operative methods and bone-grafting are separately and fully considered in later chapters. The only criticism that can be made about the book is based on its attempt at completeness tending to confusion. The reader has so many appliances and methods presented that he may become bewildered unless he has enough experience himself to appraise the value of each thing presented. Certainly no consulting surgeon or library can afford to be without this volume.

Principles of Surgery for Nurses. By M. S. WOOLF, M.A., B.Sc., M.R.C.S. (Eng.), L.R.C.P. (Lond.), Instructor in Surgery, University of California Hospital, San Francisco. Demy 8vo. Pp. 350, with 89 illustrations. 1926. London and Philadelphia: W. B. Saunders Co. 15s. net.

EVERYONE who has had to teach surgery to nurses will appreciate the difficulty of presenting the subject clearly in the compass of a small book or a short series of lectures. In the present work of twenty-four chapters the author has tried to cover the ground in such a way as to give a clear account of all the common surgical conditions and their treatment. In this we think that he has been successful, but that he would have succeeded better if he had been content to dwell on important common and typical conditions, leaving out rare things altogether. Each chapter ends in a tabular summary which is much too complicated either for reference or memory. The figures are very good, but here again too many rare things and not enough common ones are illustrated—for example, the chapter on fractures gives only X-ray illustrations, and no kind of splint, bandage, or fracture bed is figured.

Modern Methods of Amputation. By THOMAS G. ORR, A.B., M.D., F.A.C.S., Professor of Surgery, University of Kansas. Royal 8vo. Pp. 117, with 125 illustrations. 1926. London: Henry Kimpton. 16s. net.

IN his preface the author rightly insists on function as being the final test to which all amputations must be subjected. The book is divided into six chapters. The first two are the best in the book. The former of these deals with "General Considerations" and the latter with "Amputation Stumps". These sections are ably written, concise, and cover the ground well. As was to be expected considering the position and reputation of the author, the opinions expressed and the advice given are thoroughly sound on most points. He favours the aperiosteal method of Bunge for

dealing with the cut end of the bone. We cannot quite agree with the wisdom of curetting out a small quantity of the medulla from the end of the bone. The development of spurs depends on the condition and behaviour of the periosteum and not on the medulla. The next two chapters dealing with individual amputations are not quite so good. Their chief fault lies in their being too short. The value of the book would be much enhanced if more minute directions were given for the performance of some of the operations, e.g., Syme's amputation. We are glad to see the author considers it unwise, as a rule, to leave a single toe on a foot when the remainder have been amputated. The fifth chapter is devoted to 'Cinematoplastie Amputations', but we are inclined to question the wisdom of including these. In this country at any rate this method has been given up entirely on account of the great difficulty of fitting efficient apparatus, a point which is not alluded to by the author. In the final chapter artificial limbs, both temporary and permanent, are described.

The volume is well illustrated with over a hundred drawings and photographs. We can thoroughly recommend the book to the student and surgeon, though no doubt the former would be glad to receive just a little more detailed information about some of the individual operations.

Appendicite. By F. CANEVA ZANINI. 8vo. Pp. 96. 1926: Milan Soc. Editrice Libraria.

THERE is something very pleasant about a little book, hardly more than a pamphlet, which includes abstracts of its contents in English, French, and German. A critic, conscious of his own deficiencies in writing Italian, must treat the English of his Italian colleague with great tenderness; it is so nearly good that it is a pity there was not an Englishman at hand to put a final polish on the prepositions, for example, and to prevent the inclusion of 'fracture of the pelvis' among the complications of operation for appendicitis; presumably ventral hernia was intended. The opinions of a surgeon with the immense experience of the Ospedale Maggiore behind him cannot fail to be of interest, but taken as a whole the views are those that were prevalent here fifteen or more years ago: it is the period of the cry, "send your cases early, we beseech you". Professor Zanini scouts any idea of blood-borne infection or association with 'influenza' and thinks fecoliths and foreign bodies of little account: the infection is definitely enterogenous. He says that appendicitis is becoming continually more frequent in Milan, so that to-day the numbers admitted are as great as those recorded for accidents. He finds males more frequently attacked than females: the years 15 to 30 those most prone, and those classes more liable which have greater facilities for over-eating.

Occlusione intestinale. By O. MARGARUCCI and U. STOPPATO. Royal 8vo. Pp. 376. 1926. Rome: A. Manuzio.

THIS monograph, reprinted from the *Archives* of the Italian Surgical Society, embodies a report on the subject made to the Society by the authors, based in part upon materials, statistical and clinical, supplied by members, but contains also a conspectus of the literature of intestinal obstruction.

Professor Stoppato deals with etiology, morbid anatomy, and physiology; Professor Margarucci with symptomatology, diagnosis, and treatment. It is not an easy book to read, but since it is systematic it should be useful for reference despite the absence of an index. There is, in the nature of the case, little attempt to indicate the relative frequency and therefore importance of the various causes, and the statements as to the symptoms of some of the rare conditions must be founded, it would seem, on scanty information. At the same time, rarities of one clinic may be commonplaces of another, for among 468 cases of acute intestinal obstruction recorded by Bagozzi from the Ospedale Maggiore, no fewer than 168 were due to fecal accumulation.

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EPONYMS.

By SIR D'ARCY POWER, K.B.E., LONDON.

XXIV. GAMGEE'S TISSUE.

MR. SAMPSON GAMGEE, Surgeon to the Queen's Hospital at Birmingham, gave an epoch-making clinical lecture to his students on Feb. 18, 1880. He called the subject of his lecture "On Absorbent and Antiseptic Surgical Dressings", and by it gave the death-blow to the poultice which was then in ordinary use. He said in this lecture:—

"Let me detain you for a few moments with an experimental demonstration of the action of the materials employed as dressings in the cases I have been speaking about. Here is a piece of the finest cotton-wool, such as is ordinarily used by jewellers. You see it floats on water, and rises to the surface any number of times after being pushed to the bottom of the glass. It will float for weeks, as I have proved by repeated trials. I drop into a tumbler of water this pledget of cotton-wool, made absorbent by the removal of oily matter and other impurities, and you see that it sinks to the bottom in a very few seconds. I now envelope a pledget of absorbent cotton in a piece of unbleached gauze, such as is commonly used in surgical practice. In spite of the proved absorbing power of the contained cotton-wool, so impermeable is the gauze that the pledget floats and resists forcible immersion. I have had a little pad so made, floating in a tumbler of water in my study for thirty-five days. If, however, you make a little pad with the absorbent cotton-wool and the same kind of gauze, bleached, you will find the substance sucks up the water with avidity, and sinks at once. So with the bandages. Here is a piece of ordinary calico bandage: it floats in the basin like a plank on a pond. Here is a piece of open weave bandage absorbent; it sinks the instant I drop it on to the water.

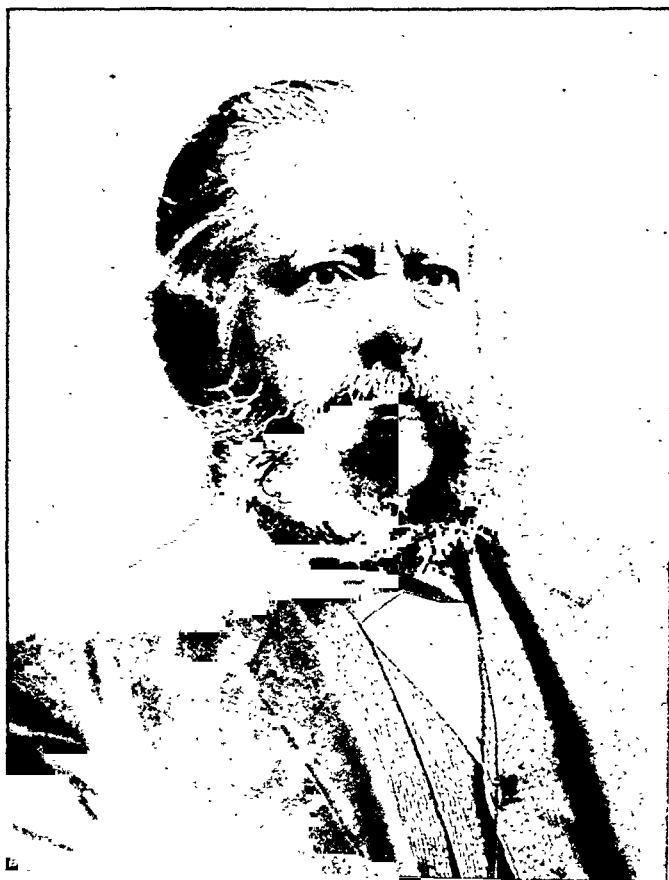
"Once I had ascertained these facts, I lost no time in putting them to the test of clinical experience, which has demonstrated the great therapeutic value of the absorbent materials; discharges drain through them so readily that wounds are kept clean and the surrounding parts dry. Union rapidly and painlessly consolidates under the elastic pressure. So great is the elasticity of the material that the pad I hold in my hand is scarcely flattened, though it has been firmly bandaged on a man's instep for five days. On

holding the pad before the fire you see it puff up at once and quickly regain its fullness and downy softness.

"It is foreign to my present purpose to detain you with any theoretical speculations. Let us get at the facts before we speculate. Certain it is, that the perfect softness and elasticity of these absorbent materials are of the utmost practical value and comfort. Those qualities render possible, with the most perfect safety, the application of that elastic compression, which, with rest and position, is so potent in relieving local congestion and inflammation. That therapeutic action is most clearly and convincingly demonstrated in cases of injury unaccompanied with wound. Of all surgical agencies none is so beneficent as compression, none requiring more delicate manipulation, none so inadequately appreciated. Under a smooth and uniformly, while lightly, compressing bandage, applied to the head, the trunk, or the limbs, extravasations of blood are absorbed, the healing action is promoted and a soothing influence is exercised. There must be no constriction—only equable adaptation of surface to surface, with the light pressure which always comforts. There must be no squeezing like that of an old college friend's hand, when seen after a long absence; such pressure as that, on tender parts, is intolerable constriction. The soothing surgical pressure is like that which you interchange with the hand of a lady, when the pleasure of meeting her is tempered by a respectful regard. Your hand adapts itself to hers, and gently presses it wherever it can touch it, but nowhere squeezes it for fear of offending. Such pressure when employed by the surgeon in the treatment of injuries, always soothes and heals.

"The greatest comfort is experienced when one of these layers of absorbent cotton in a double layer of similar gauze is applied in cases of inflammation of the lungs where the weight of a linseed poultice is found to be intolerable. When held before the fire the material puffs up, and is placed on the chest warm and soft as the finest down. The idea was suggested to me long since in reading the chapter on muslin and cotton-wool in the rare and most instructive essays on 'Simplified Surgery' published at Brussels in 1842 by Mayor, of Lausanne. I had often tried the application, but it was evident that the famed muslin manufactories of Switzerland had furnished better materials than I had hitherto been able to obtain. I found that ordinary cotton-wool and muslin did not work up well. This absorbent gauze and cotton-wool, however, is perfect, and I foresee that in many other cases, especially in dressing burns, blisters and bed sores the new tissue cannot fail to prove most useful. Obstetricians to whom I have suggested the use of these pads in child-bed, instead of napkins, have approved the idea and put it to the test of experience, which has been so far unanimously satisfactory. It is obvious that it must be most conducive to purity, and opposed to infection, to receive the natural discharges into a very readily absorbent and powerfully antiseptic pad, of downy softness, that is changed as often as is necessary and immediately burnt. On this point, however, having no obstetric practice myself, I cannot speak with any authority and only venture to suggest."

It may perhaps be interesting to notice that Dr. Mathias Mayor, of Lausanne, to whom Gamgee attributes the original idea of an absorbent



SAMPSON GAMGEE

1828-1886

dressing, was the first in Switzerland to use the stethoscope for the purpose of hearing the foetal heart, and that he practised this form of auscultation on his wife before the birth of their son, who is happily still living. Mr. Sampson Gamgee within the compass of a single clinical lecture not only introduced a form of dressing which has since become a household word, but was also able to foreshadow nearly all the uses to which it has since been put.

Joseph Sampson Gamgee was the eldest son of Joseph Gamgee, a veterinary surgeon. He was born at Leghorn in 1828, and in the following year the family moved to Florence, where he was educated. He went to London in 1847 and was entered as a student at the Royal Veterinary College in Camden Town in order that he might follow his father's profession. He obtained his diploma as a Member of the Royal College of Veterinary Surgeons and then proceeded to University College, where he gained several gold medals and the Liston Prize for Surgery. He became a Member of the Royal College of Surgeons of England in 1854 and was appointed Surgeon to the British Italian Legion in 1855, being placed in charge of the hospital at Malta during the Crimean war. He was appointed Surgeon to the Queen's Hospital at Birmingham in 1857 and served both the hospital and the medical school with the greatest zeal until 1881. He was always strongly opposed to indiscriminate hospital relief, and in 1873 he was instrumental in starting the 'Hospital Saturday' collections in Birmingham, especially in factories and workshops. He married in 1860 Miss Marion Parker, by whom he had seven children. He died in 1886. His youngest brother was Arthur Gamgee [1841-1909], the first Brackenbury Professor of Physiology in the Owens College, Manchester, now the Victoria University, who, as Dean of the Medical School, did much to make it a conspicuous success.

For the portrait I am indebted to his son, Mr. Leonard P. Gamgee, F.R.C.S., Joint Professor of Surgery in the University of Birmingham and Surgeon to the Birmingham General Hospital.

THE SURGICAL TREATMENT OF THE 'DE-GLOVED' HAND.

By G. H. COLT, ABERDEEN.

It has been too often assumed that a finger which has been completely skinned by an accident must be amputated. I hope to show that it should be possible to save and restore to functional use even the whole hand when injured in this manner.

Case 1.—On Dec. 5, 1919, Robert W., age 16, had his right hand caught in the hot rollers of a paper machine and all four fingers were completely skinned down to the aponeurosis from the level of the knuckles downwards.



FIG. 380.—*Case 1.* Four and a half months after accident.

about, the hand removed, and the flaps were folded round it like a mit. Some sloughing occurred on the palmar surface, where all along the chief suppuration had lain. A month later the raw area on the abdomen was grafted. *Fig. 380* shows the condition of the hand four and a half months after the accident. At this stage a screw clamp separator was used to try to prepare the way between the middle and ring fingers. In the middle of June,

The tip of the distal phalanx of the middle and the whole distal phalanx of the ring finger were absent. There was a fracture of the middle phalanx of the middle finger, but it was not compound through the fascia. While deputizing for Professor Mar-
noch, to whom I am indebted for permission to publish the case, I saw the patient, and it naturally seemed to be a great misfortune to allow the fingers to be amputated. They were much soiled with grease and dirt. After being cleansed with ether and weak biniodide lotion they were placed inside the skin of the hypogastrium and the wound was drained. It suppurated severely and the fingers became contracted, but fortunately no sepsis spread up the arm. Six weeks later the skin was cut into flaps round

six and a half months after the accident, a pinprick was felt on the ulnar side of the dorsal surface of the mit. The middle and ring portions of the mit were separated and the palmar scar was excised. It was found that there was much internal scarring and the amount of skin was deficient. Most of



FIG. 381.—Case 1. Nine months after accident.

the middle finger was removed, and Fig. 381 shows the condition. On Aug. 10 (nine months) light touch was felt on the ulnar side of the inner fin. The ring finger was amputated through the distal part of the proximal phalanx, and on Dec. 1 more scar tissue and part of the remaining middle phalanx of

This is written with my right hand.

R. Wilson

2nd December 1926

FIG. 382.—Case 1. Specimen of patient's writing seven years after accident.

the index finger were removed. These losses were due to scar tissue and insufficiency of skin. In March, 1921 (fifteen months) the patient was able to use the hand for writing. A specimen of his writing at the present time



Figs. 383-386.—*Case 1.* Condition of hand seven years after accident.

is appended (*Fig. 382*). The specimens do not differ much. Light touch and pinprick were felt all over the stumps. Heat and cold were felt, but the latent period for heat was longer than that for cold. He could pick up a pin and grasp small objects firmly.

Since that time the patient has supported himself by photographic work for a year, and for the last four years by driving a motor van with right-hand controls. He has been married for a year and will be able to exercise due control over his son. *Figs. 383-386* show the present condition, seven years after the accident. The skin is somewhat cold and blue in bad weather, but not painful, and it is extremely supple. The two fins move freely and independently, and the grasp is good.

An inference to be drawn from this case is that the abdominal wall is unsuitable for the purpose of the operation, because dependent drainage is difficult to secure and because pressure cannot be exercised to keep the fingers straight and separated from the beginning. How far pressure would be necessary on the abdominal wall if separate pockets were made for each digit is not yet known. The case was shown when the Chirurgical Club visited Aberdeen, and members will remember that for the reasons given the upper part of the thigh or hip was considered suitable in any future case, as advocated by Schroeder¹ in cases of secondary operation for burns. This case has now occurred.

Case 2.—Mrs. Jessie H., age 48, a well-nourished woman, was descending a movable stair ladder from a loft on April 24, 1926, holding the edge of the floor above with her right hand. The trap fell on her hand and the ladder slipped away with the result that her right hand was skinned on the dorsal aspect from the level of the distal crease of the wrist and on the palmar aspect from the level of the metacarpophalangeal joints downwards. The three outer fingers were involved completely and the nails were absent. The thumb and little finger escaped. The index finger had been torn off through the proximal phalanx. The patient had the sense to leave the skin where it was and to wrap the hand in a clean towel. She was brought to the infirmary and was admitted. The operation was begun about two and a half hours after the accident. Under general anaesthesia the hand was cleaned and disinfected with ether and a flavine bath and the tendons of the index finger were sutured over the stump. The edges of the torn skin were excised and a flap was raised in the thigh of a size and shape corresponding to the skin which was missing from the back of the hand. It is as well to mention that a mistake was nearly made by reason of the patient's arm being relatively short, but this was noticed in time. It is a point to note for the future so as to ensure an easy lie for the limb and an absence of tension in the flaps. Three tunnels were divulsed in the subcutaneous tissue and the three injured fingers were drawn into them from counter openings at their distal ends. Drains were inserted at the openings and also dependently to the deep surface. As subsequently appeared the tunnels were too near together. A point of great practical importance thus presented itself—namely, in the future to make all the tunnels as divergent as possible, as I find Schroeder points out. This fixes each finger securely, supplies a supple web, and yields more skin for covering the dorsal surface. The skin of the forearm was sutured to the

loin, so that if the patient moved, the drag would warn her to keep still. It appeared, however, that this is unnecessary in a well-nourished patient, as also



FIG. 387.—Case 2. In the figure the dot indicates the position of the anterior superior iliac spine. The crosses show the positions of the ends of the fingers, and the slots the places where drainage was provided. In addition dependent drainage was provided under the original outer flap. There are four stitches on the inner flap.

is a plaster casing, for a firm binder will keep the limb secure, and in a thin



FIG. 388.—Case 2.

patient a pad would fill the gap at the loin. The fixation by separate tunnels also renders the use of a stent mould unnecessary. This was employed on the eighth day to aid the separation. If it became misplaced it might cause injurious pressure. Evenly distributed pressure by means of a careful arrangement of the dressings is sufficient. The drains were removed on the third day, when it was apparent that any violent sepsis was absent.

The skin of the outer flap was incised and sutured to the adjacent subcutaneous tissue a month after the primary operation. A week later the flap was separated and wrapped round the ring finger. The tip of the flap died. Fig. 387

shows the general arrangement of the parts. The inner flap was treated



FIGS. 389-391.—Case 2.

similarly, but four days later than the outer, and allowed to lie a fortnight before it was separated and wrapped round the remains of the index and middle fingers. The hand was thus freed forty-five days after the accident. The inner flap was initially made too short and it contracted somewhat, so that the terminal phalanx of the middle finger had to be removed (*Fig. 388*). The raw area on the thigh was grafted a fortnight after the hand had been freed, but owing to faulty design in the dressing the grafts did not take and healing was correspondingly delayed. About the end of June some degree of sensibility was present in the transferred skin, and at the end of July, three months after the accident and from five to seven weeks after the flaps were wrapped round, protopathic and epicritic sensibility were present over nearly all of it. The speed with which sensibility returned in this case seems to be remarkable and should prove an interesting source of more accurate inquiry in the future. No doubt much depends on the degree of integrity of the digital nerves if they are left behind by the accident; but even if they were intact, the phenomenon is not readily explicable.

At this stage a scar remained on the palm between the index and middle fingers. It was excised freely and the fingers were separated. There was not enough skin to make the covering complete. The remains of the index finger were therefore removed; in fact, it would have been better to have done this at the beginning of this particular operation. *Figs. 389, 390* give a general idea of the present condition, and *Fig. 391* shows the X-ray appearance. It is not proposed at this stage to operate again. The fingers are somewhat unsightly, but the nutrition is good and they do not become cold in bad weather. Partly perhaps owing to the original injury, they are still somewhat stiff, but this is improving daily. It will be interesting to see if much shrinkage occurs in the subcutaneous tissue and if the skin becomes glazed. The grasp is excellent. [Since this was written and 10 months after the injury, the top of the middle finger is conical, and may perhaps have to be removed. Shrinkage continues slowly. The skin is normal in appearance, and is becoming supple. The ring finger measures 3 inches in circumference, as compared with 2 inches for the left side.]

These two cases are of great interest and have been described in such a way as to indicate the difficulties that may occur. They show that it will generally be advisable to try to save as much as possible of fingers denuded of skin even at the risk of some degree of sepsis. While the initial injury might leave the general structure of the hand and fingers intact, except that they are devoid of covering down to the aponeurosis, it might also compress and scrape the structures, thus causing fractures, dislocations, avulsions, sprains, and other injuries. Sepsis might not only invade the pocket into which the hand is placed but might also travel up the limb. It seems to me that in most cases one would get warning of this in time to enable the process to be cut short. The patient should therefore have the chance of the parts running an aseptic course at this stage, as indeed occurred in *Case 2*. Such a course enormously reduces any after-trouble from the formation of dense scar tissue internally such as marred *Case 1*. It is clear also that placing the digits into separate pockets might limit the spread of infection. In certain

instances one finger could be freed and if necessary amputated, or an individual pocket could be treated separately without disturbing the rest of the arrangement.

Fig. 392 is a diagram of the scheme proposed for treating the whole hand, and it would be modified according to the degree of injury or the course of the case. It seems to me that lateral wrapping of skin-flaps, i.e., the 'mit' idea, is wrong except for the outer and inner fingers and for the palm of the hand—that is to say, the production of a fin or flapper as an intermediate stage is wrong. The essential thing is to make the fingers diverge from the start, and to attain this by lodging them in separate pockets, thus ensuring the other attendant advantages that have been mentioned. The only slight technical difficulty in doing this is due to the relatively large size of the proximal interphalangeal joint in the skinned middle finger. There is difficulty in pulling the digit into the tube. In the figure it will be noticed that somewhat elongated tubed-pedicle flaps have been drawn for the middle and ring fingers. This method is almost certain to be necessary in practice because the width of skin required to cover the palmar surface of each finger is $\frac{1}{2}\pi D$. The diameter at the proximal interphalangeal joint being about $\frac{3}{4}$ in., the width of the flap must be at least $1\frac{5}{8}$ in., even if only the normal amount of subcutaneous tissue were included. In practice much more than this has to be taken or the flap would not live. Schroeder (loc. cit.) suggests $\frac{1}{4}$ in. If two adjacent fingers are to be left covered before they are separated, the flap becomes so wide that it is non-viable except perhaps proximally. Subsequent writers refer to the clumsiness caused by using too thick a covering, but until the probable shrinkage coefficient is known this must continue. It is proposed to disconnect the tubed pedicles as a preliminary and separate stage to that of freeing the hand as a whole, and to open and stitch them in position either then or later. It seems that a good deal will depend on the facilities that exist at the operation for keeping the flaps warm. The adjustments and stitching are apt to take a relatively long time, and it might be most advisable to carry out this part of the operation on some kind of warm stage. The advantage of leaving behind strips of unused skin between the beds of the fingers is obvious.

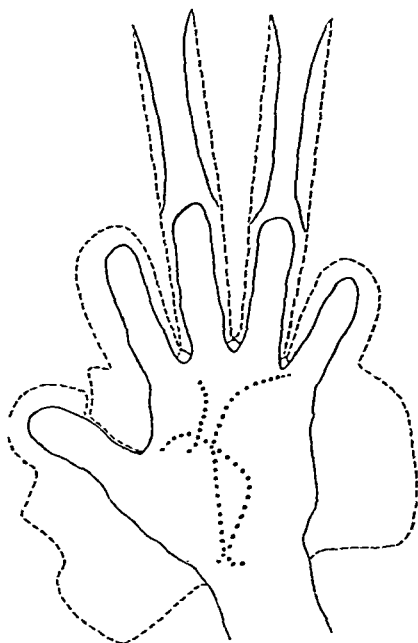


FIG. 392.—The diagram shows a scheme for covering the entire hand, back and front, with skin from the region of the hip. Some of the flaps might have to be larger according to the thickness of the subcutaneous tissue utilized. The dots indicate the possible excess or deficiency in the palm, and these would be allowed for.

In Schroeder's cases (loc. cit.) the operations were secondary ones which

were undertaken for deformity due to burns and injuries. He points out the great advantages of the double-pedicle flap in providing a covering which is mobile, elastic, and certain in taking. In McWilliams' case,² treated secondarily for scars following burns, "sensation had returned in the flap to about one quarter of its extent" nine months after the first operation and eight months after the hand had been released. In Foote's case³ tactile sensation was present in part of the transplant, and pain was felt over a large area on pulling the hairs one year after operation. In Semken's case⁴ sensation had returned to a considerable degree a year after operation. Two interesting questions therefore suggest themselves—namely: (1) In a secondary case are the nerves strangulated by fibrous tissue and later prevented from sprouting? (2) In a primary case, remaining aseptic and with much less strangulation, does a 'skin stimulus' to nerve growth and end-organ formation exist and cause the rapid appearance of sensibility?

No primary cases are found in *Surgery, Gynecology and Obstetrics*, Vol. I (1905) to Vol. XLII (1925), which may perhaps be taken as a criterion that the method, if it has been employed at all, has not been used often.

In Case 1 it might have been better to have waited a few days before inserting the hand. The immediate risk of waiting is that the fingers will die in whole or in part unless provided with a warm and nourishing covering. The secondary risk is that they will become stiff from the formation of fibrous tissue. Case 2 at the present time lends support to the proposal that if a reasonable chance of aseptic healing exists the operation should be undertaken as a primary one.

My house-surgeon suggested that the procedure should be termed 'cheiro-dactylo-derma-plasty'.

SUMMARY.

Two cases are described to illustrate how fingers that have been completely skinned may be saved by a primary plastic operation.

Certain technical details are given as being likely to prove useful in future cases. In these an exact examination should be made of the return of sensibility in the transplanted skin. All such cases should be published so that the chances of success may become known and the application of the method extended to cases of more extensive and deeper injuries.

I am indebted to Miss Nancy Kelly for her drawing of *Fig. 387*, and to Dr. William Brown for *Figs. 389 and 390*.

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- ¹ SCHROEDER, *Amer. Jour. Med. Sci.*, 1900, Oct., 435.
- ² McWILLIAMS, *Ann. of Surg.*, 1917, ii, 598.
- ³ FOOTE, *Ibid.*, 1918, i, 629.
- ⁴ SEMKEN, *Ibid.*, 1924, i, 465.

RECONSTRUCTION OF THE ANTERIOR CRUCIAL AND INTERNAL LATERAL LIGAMENTS OF THE KNEE-JOINT.

A RECORD OF ELEVEN CASES.

BY MAURICE HORAN, CHEPSTOW.

ALTHOUGH not a condition frequently met with in civil life, a not inconsiderable number of cases of injury to the knee-joint associated with rupture or stretching of the anterior crucial ligament have come to notice since the War, mainly the results of the violent strains of the joint to which the soldier on active service is exposed. Damage to the internal lateral ligament is invariably present. References to the condition in literature are meagre; records of results of treatment by the various methods which have been employed are scanty and lack conclusion.

A review of a series of cases in which reconstruction of the ligaments involved has been performed, and an endeavour made to follow up each case and examine the end-result, is put forward in this paper.

The series under consideration include eleven cases, all of which have been operated upon by Mr. Alwyn Smith. Eight of these have been personally observed over periods varying from six months to three years. Information regarding the remaining three has been obtained by reference to their medical documents, the patients being War Pensioners, and by a written communication from each concerning what he himself felt regarding his condition and ability to work. As they were pensioners, a certain degree of caution in the replies was not unexpected.

The method adopted in all cases has been the modification of Hey Groves' operation described by Mr. Alwyn Smith some years ago.¹ Briefly, this consists in exposure of the joint through a J-shaped incision, the long arm running down the outer side of the thigh, passing below the tubercle of the tibia, and turning up over the inner aspect of the knee. The patella is exposed, split vertically, and its halves are drawn apart. The external condyle of the femur and internal tuberosity of the tibia are now drilled in the line of the anterior crucial ligament; a strip of fascia lata $1\frac{1}{2}$ in. wide is then turned down from the thigh, and drawn through the tunnel in the condyle and tibial tuberosity. The adductor tubercle is drilled subcortically, and the free end of the fascial strip is passed up through this tunnel, turned down on itself, and sutured. In this manner replacement of the anterior crucial and internal lateral ligaments is sought.

The period elapsing between the receipt of injury and the date of operative treatment, in the series under consideration, varied from one to eight years. The conditions found at operation ranged from complete rupture of both crucial, and tearing or stretching of both lateral, ligaments, as in *Case 3*, to stretching and atrophy of the anterior crucial ligament combined with

damage to the internal lateral ligament. In those cases where previous exploration had not been performed, a loose, or more generally a torn, internal meniscus was present.

Case 3 was exceptional in that both crucials and both lateral ligaments were torn; this was the only case in the series where the posterior crucial was found torn through. Instability of the joint was so marked that at times the act of walking assumed a hazardous aspect, despite the support of a knee-cage. Operation has secured for the patient a joint sufficiently stable to afford complete security in walking, although he still requires a knee-support as a provision against exaggerated movement or wrenching of the joint.

Case 7 is of considerable interest. Five years after the reconstructive operation, arthrodesis was performed in view of the *non possumus* attitude of the patient, although the joint appeared perfectly stable, even when examined under anæsthesia. The joint was excised intact, and the illustration (*see Fig. 396*) shows well the appearance of the 'new cord-like ligament' as photographed on removal. Behind this lies the anterior crucial ligament proper, which, at the operation five years ago, had been found stretched. It had contracted up, and appeared as a firm rounded band. The specimen appears to demonstrate two facts. Recently in a paper describing a method of operation for repair of the crucial ligaments² it was suggested that fascia lata, separated from its source of vascularity and being a comparatively low type of tissue histologically, must degenerate and yield. It would not seem that the deduction has any very sound basis in fact. The investigations of Gallie and LeMesurier³ show that, given an adequate supply of lymph, such fascial strips or transplants can retain their vitality independently of their vascular connections, and the specimen reproduced here affords a good illustration of this.

A second point shown by the specimen is the effect of the operation in the case of a stretched, as distinct from a torn, crucial ligament. By the assumption of the functions of the stretched ligament by the fascial substitute, and the consequent placing at rest of the damaged structure, more or less complete repair can be obtained.

CASE REPORTS.

Case 1.—N. G. W., age 33. Fell whilst jumping in 1914, a comrade falling across his knee. Admitted to hospital in July, 1926—marked anteroposterior mobility of the knee-joint, which was also mobile in the lateral direction. The tibia could be glided forwards on the femur in extension. There was a history of increasing insecurity of the joint accompanied by the knee giving way under him on making a false step, followed by his falling to the ground. Operation on July 7 by the usual method—very vascular joint, with degeneration of synovial membrane. The anterior crucial ligament was found torn; internal lateral ligament also torn. The internal semilunar cartilage was loose and fractured. The patient was discharged on Sept. 9 to continue physiotherapeutic treatment as an out-patient.

Case 2.—G. F., age 29. Buried by shell-burst in 1917, had cartilage removed in 1919. Admitted to the hospital in January, 1925, with a history of the knee giving way under him when his attention became distracted from it. Anteroposterior and lateral mobility were marked. Operation in January, 1925, by the usual method—the anterior crucial and internal lateral ligaments were found torn.

Mr. Naughton Dunn has very kindly supplied a note regarding this case, dated March 9, 1926.

"My note of November, 1924, reads as follows: 'Extreme laxity of right knee-joint suggesting complete rupture of both crucial ligaments. Knee unstable, especially in abducted position. The condition should be regarded as a more serious disability than arthrodesis.'

"I have to-day examined F. clinically. There is still some joint laxity of the knee-joint, both in the anteroposterior and lateral directions, but this is very much less marked than prior to operation. Rough grating is present in the joint suggestive of rheumatoid changes. The man can hop on the knee and bear weight on the joint in the slightly flexed position. He himself states that the knee is very much



FIG. 393.—Case 5. Left knee, front aspect.

better than prior to operation, but that he has not yet sufficient confidence in the joint to enable him to return to work which would involve climbing."

This patient has since returned to work, which he performs without the aid of any mechanical support.

Case 3.—J. D., age 29. Buried by explosion at a gun-pit in 1918. Admitted to hospital, January, 1925. Marked mobility in anteroposterior and lateral directions. The tibia could be readily abducted and adducted on the femur, in addition to being manipulated forwards on the femur in extension, and backwards in flexion. The patient wore a knee-cage, but complained of the utter insecurity of the joint,

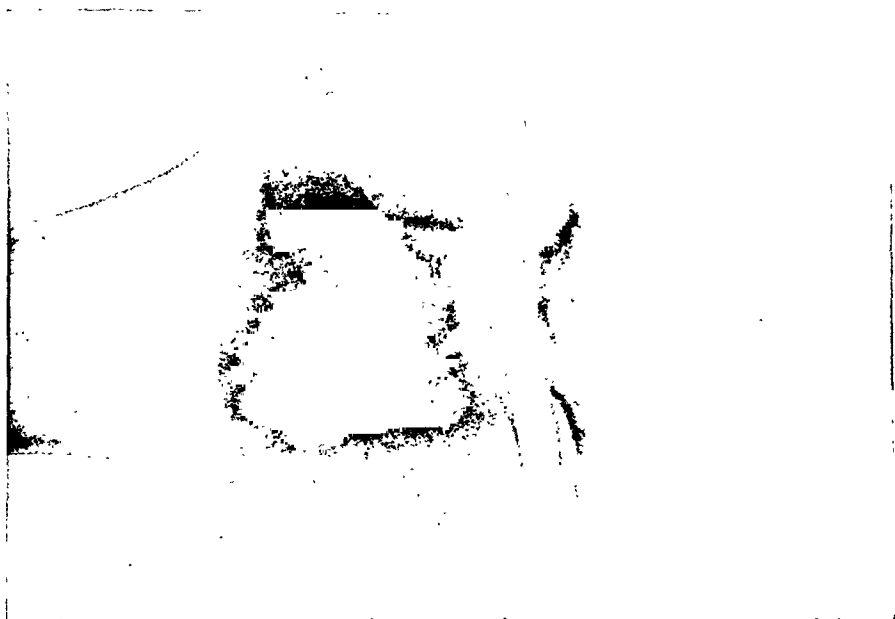


FIG. 395.—Case 6. Right knee, front aspect.

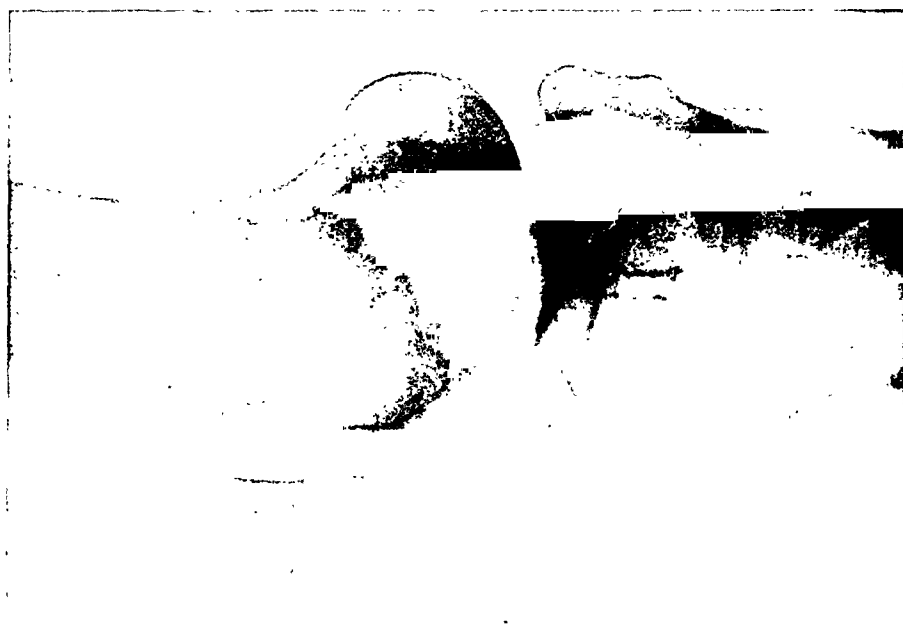


FIG. 394.—Case 6. Right knee, inner aspect.

involving frequent falls. Operation in January, 1925, by the usual method—both crucial ligaments found torn across; both lateral ligaments much stretched, very large fat pad, and internal meniscus loose. Second operation in July, 1925. External lateral ligament reconstructed from biceps tendon. The patient was discharged from hospital in December with a knee-cage. Some degree of mobility in both anteroposterior and lateral directions was still present; he could, however, walk quite securely without a support on level ground. He expressed himself as feeling "much more secure and not afraid to walk".

Case 4.—J. H., age 32. Injured knee whilst playing football in 1918. The internal semilunar cartilage was removed in 1923, for pain and locking of the joint. Admitted to hospital in June, 1924, with a history of the knee giving way under him. The patient has had no locking since the former operation. Anteroposterior and lateral mobility were present. He can glide tibia forward on femur voluntarily with a peculiar jerking movement. Passively, the tibia could be manipulated forwards on the femur in full extension. Operation in June, 1924, by the usual method—anterior crucial ligament stretched and slack; internal lateral ligament torn.

Present Condition.—Movement full, no abnormal mobility. He states: "I am very pleased with the result of the operation. The whole joint seems quite secure, and I do my work of crane driver every day without any bandage or support."

Case 5.—T. G. age 33. (Fig. 393.) Crushed by ammunition wagon, 1915, sustaining a fracture of the lower third of the femur. Admitted to hospital in June, 1922, with a history of knee giving way. Marked abnormal mobility of joint, with tenderness over inner aspect. Flexion limited to 100°. Operation in June, 1922, by the usual method—

anterior crucial ligament was found ruptured, and internal lateral ligament stretched; semilunar cartilage macerated. In this case, following discharge from hospital, the patient was supplied with a knee-cage, with subsequent deterioration. This was remedied by a course of physiotherapy, and when examined in 1925 he had developed a really remarkable musculature of both thigh and leg.

Present Condition.—No abnormal mobility, full flexion and extension. Prior to the coal strike, he was working as a collier underground.

Case 6.—T. L., age 43. (Figs. 394, 395.) Injury to knee whilst playing football in 1914. Operation for removal of cartilage in 1919. Admitted to hospital in June, 1920, with abnormal mobility of knee in anteroposterior and lateral directions. Much grating present on movement. Operation in July, 1920, by the usual method—anterior crucial ligament found torn. The patient was supplied with a knee-cage following discharge from hospital, but this was discarded in 1924 on instructions.

Present Condition.—Flexion to 150°; extension full. Grating present on movement, no undue anteroposterior mobility. Working as a collier underground prior to the coal strike.

Case 7.—G. R., age 42. Injury to knee in 1917. Admitted to hospital in July, 1920, with abnormal mobility of knee in anteroposterior and lateral directions.

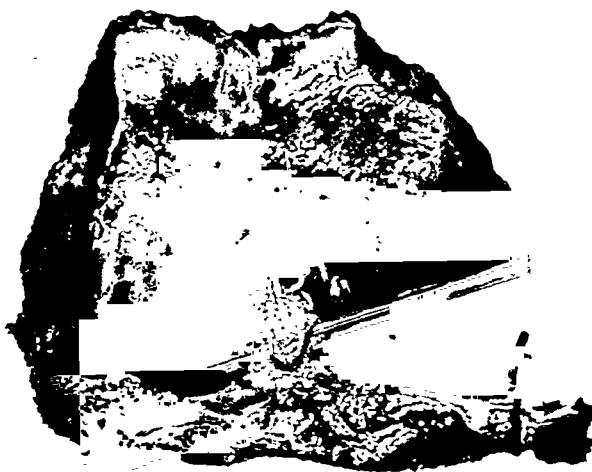


FIG. 396.—Case 7. Excised joint with reconstructed crucial ligament in situ.

Operation in July, 1920, by the usual method—anterior crucial ligament found stretched, and internal lateral ligament damaged; semilunar cartilage loose and torn. Following discharge from hospital, he returned to work. In November, 1923, he fell and wrenched his damaged knee. Re-admitted to hospital in 1925, complaining of weakness and insecurity of knee-joint. The joint appeared stable; no abnormal mobility in either direction; musculature good. The patient was very insistent on having a stiff knee, and arthrodesis was performed. *Fig. 396* shows the excised joint with the reconstructed crucial ligament *in situ*.

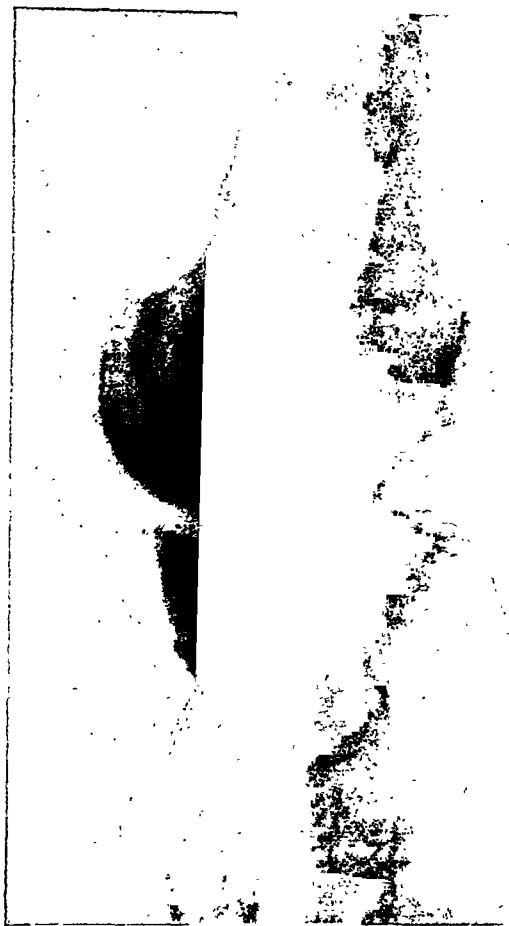


FIG. 397.—Case 8. Left knee, inner view.

Case 8.—J. E. N., age 40. (*Fig. 397.*) A shell struck the bridge over which the patient was passing in 1916, his right leg slipped through a gap, and he fell forward. An operation for removal of internal semilunar cartilage was performed in 1918. He was admitted to hospital in February, 1920, with a history of the knee giving way under him on making a false step. The tibia could be manipulated forward on the femur with the joint extended; lateral mobility present. Operation in March, 1920, by the usual method—anterior crucial ligament found torn across.

Present Condition.—Full flexion and extension present, no lateral mobility. Slight degree of anteroposterior mobility present, marked grating in joint on movement. Working as collier; his chief trouble is aching in the joint, which is the seat of osteo-arthritis.

The remaining three cases have not been examined personally; the notes on each are taken from their case sheets, medical documents of the present date, the men being war pensioners, and in *Cases 10 and 11* from personal communications received from the patients.

Case 9.—F. R., age 44. Injury to knee in 1915. Had operation for removal of cartilage in 1915. Admitted to hospital in January, 1922, with complaint of insecurity of knee-joint. Abnormal mobility present in anteroposterior and lateral directions. Operation in February, 1922, by the usual method—anterior crucial ligament found torn. Placed in plaster for two months following operation.

Present Condition (documentary).—Wears calliper. Flexion of knee limited to 90°. Thigh measures $1\frac{1}{4}$ in. less than on sound side.

Case 10.—J. P., age 30. Injury to knee in 1918 (displaced internal semilunar cartilage). Admitted to hospital in May, 1920, with unstable knee; anteroposterior mobility present. Operation in May, 1920, by the usual method—anterior crucial ligament found stretched; cartilage loose.

Present Condition (documentary).—Full movement present; slight anteroposterior mobility of joint; no wasting of thigh. Working.

Case 11.—O. P., age 38. Injury to knee in 1915. Operation for removal of cartilage in 1915. Admitted to hospital in July, 1920, with history of the knee giving way beneath him on taking a false step or walking over uneven ground. Abnormal mobility of joint in anteroposterior and lateral directions. Operation in July, 1920, by the usual method—anterior crucial ligament found torn. Immobilized for six weeks after operation.

Present Condition.—He writes: "I cannot do the work I did before I enlisted. My knee gives way after a hard day's work".

SUMMARY.

1. Reconstruction of the anterior crucial and internal lateral ligaments of the knee-joint from fascia lata has been performed in a series of eleven cases of tearing or stretching of these ligaments.

2. Examination of the results of the operation after periods varying from one to six years has been possible in ten of these; the remaining case dates from the present year.

3. The operation results in a joint capable of withstanding the stress and strain to which it is subjected in the course of ordinary and average life.

4. Early and thorough re-education of the musculature of the limb is important to success. Prolonged immobilization of the joint by splinting or plaster following operation is to be avoided, as is the mechanical support of the joint at a later period by a knee-cage or similar appliance, with the inevitable atrophy and impaired support of the musculature governing the joint.

I wish to express my gratitude to Mr. Alwyn Smith for his assistance in enabling me to examine these patients for the purpose of this paper, and for the use of the photographs; also to Mr. Naughton Dunn for kindly furnishing a note on *Case 2*. I am indebted to the Director General of the Ministry of Pensions for permission to publish the cases.

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- ¹ HEY GROVES, E. W., *Brit. Jour. Surg.*, 1918, vi, 181; *Ibid.*, 1919, vii, 505.
- ² SMITH, ALWYN, *Ibid.*, 1918, vi, 176.
- ³ EDWARDS, A. H. *Ibid.*, 1926, xiii, 432.
- ⁴ GALLIE W. E., and LEMESURIER, A. B., *Ibid.*, 1924, xii, 289.

A CASE OF AN INTESTINAL SAC AT THE SITE OF MECKEL'S DIVERTICULUM.

By F. JOSELIN JAUCH, LONDON.

J. C., MALE, age 46, a porter, was admitted under my care at the German Hospital, Dalston, on Oct. 14, 1926, complaining of recurrent attacks of abdominal pain.

HISTORY.—Since the age of five or six the patient had experienced irregular attacks of lower abdominal discomfort, amounting occasionally to actual pain, and latterly of borborygmi, but no colic. Between the attacks he had been completely free from symptoms. Five or six years ago he had a severe attack of pain in the left iliac fossa, radiating to the right. This was followed by the formation of a swelling in the right lower quadrant which was 'dispersed' by enemata. He was confined to bed for about three weeks with fever and pain localized to the right side. Further attacks occurred ten to thirty minutes after meals for four years, and ended with repeated and copious vomiting; neither this nor food relieved the pain. There were occasional eructations of clear sour fluid accompanied by some nausea. The bowels were not usually regular, and there was a tendency to constipation. During the last three to four months he had lost about 12 lb. in weight. On two occasions he was admitted to hospital with symptoms of acute intestinal obstruction, which were relieved by enemata.

ON ADMISSION.—The patient was found to be tall but of spare build; his general condition was poor. The abdomen was tender over the right rectus near the umbilicus. No tumour was palpable. Rectal examination was negative. Radiographic examination revealed nothing abnormal.

OPERATION.—Under ether anaesthesia laparotomy was performed, a right paramedian incision being employed. The stomach, duodenum, gall-bladder, and colon were normal. The appendix was bound by a few adhesions and was removed. On following up these adhesions towards the left side, a swelling was revealed in the pelvis which appeared to be a dilated portion of the ileum $25\frac{1}{4}$ in. (63 cm.) from the ileocaecal valve, and was taken to be an unusual type of Meckel's diverticulum. The mesentery of this portion of intestine showed considerable thickening, obviously the result of chronic inflammation. The portion of the intestine was resected and a lateral anastomosis made. No other dilated portions of intestine or diverticula were noted. The abdomen was closed in layers.

The patient progressed favourably until the sixth day following the operation, when he suddenly developed peritonitis from a leakage of the line of suture, shown post mortem to be due to premature absorption of the catgut employed.

DESCRIPTION OF PART REMOVED.—The actual 'tumour' (*Fig. 398*) appears to be a dilatation of the antimesenteric portion of the ileum, of roughly ovoid shape, with two minor accessory sacs on its distal border. The afferent portion of intestine is dilated and hypertrophied. The efferent part has a smaller

diameter than normal and is slightly thickened at its junction with the sac, where the mucous membrane has a valve-like form, admitting a pencil 6 mm. in diameter; it reminds one of the ileocaecal valve. The wall of the sac is of variable thickness, measuring from $\frac{3}{4}$ mm. to $3\frac{1}{2}$ mm. in different parts. It is most attenuated at its peripheral border. Externally it is completely covered by peritoncum, except, of course, at the mesenteric border; internally it is covered by apparently normal mucous membrane with very occasional follicles and a few rugae typical of this part of the ileum. The middle coat is hypertrophied here and there, and the muscular strands are

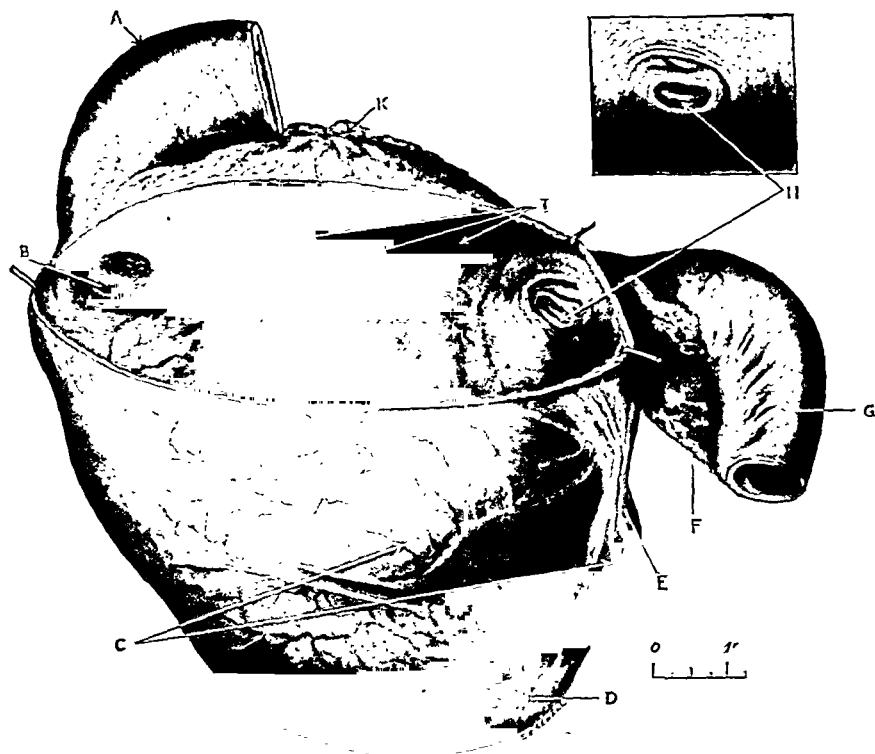


FIG. 398.—Diverticulum opened from behind. A, Afferent loop showing hypertrophy and dilatation; B, Point of entry; C, Accessory dilatations; D, Scar from previous ulceration; E, Local contraction; F, Mesentery; G, Efferent loop; H, Point of exit, showing valve-like arrangement of mucous membrane. I, Dilated blood-vessels; K, Mesentery (cut short).

visibly thickened and can be seen spread over the whole of the sac. At one point on its exterior, near the distal border, there is some scarring $\frac{2}{3}$ in. (1 cm.) across, suggesting a cicatrix from previous ulceration.

The blood-vessels show moderate enlargement and are distributed over the surface of the sac. No cord was found projecting from the surface, as is the case with some varieties of Meckel's diverticulum. In the fresh state it contained intestinal contents usually found in the lower ileum. Its capacity is 845 c.c. ($1\frac{1}{2}$ pints), and at its base (mesenteric border) it measures $5\frac{1}{4}$ in.

(13.2 cm.). The longitudinal diameter is $7\frac{1}{4}$ in. (18.2 cm.), the vertical $5\frac{3}{4}$ in. (14.4 cm.), the anteroposterior $4\frac{1}{4}$ in. (10.6 cm.); the vertical circumference is $17\frac{1}{4}$ in. (43.1 cm.), and the horizontal $13\frac{1}{4}$ in. (33.1 cm.).

Histologically, the sections (*Figs. 399, 400*) show the three coats typical of the ileum. The muscular coat, both annular and longitudinal, however, is much hypertrophied in different parts, especially near the mesenteric border. The mucous membrane consists of simple tubular glands, occasionally coiled, simulating pancreatic tissue and very occasionally of the antler type, and composed of columnar cells with occasional mucus-secreting goblet cells. At no point do the glands penetrate the underlying musculature. Lymphoid tissue is but very sparsely distributed.

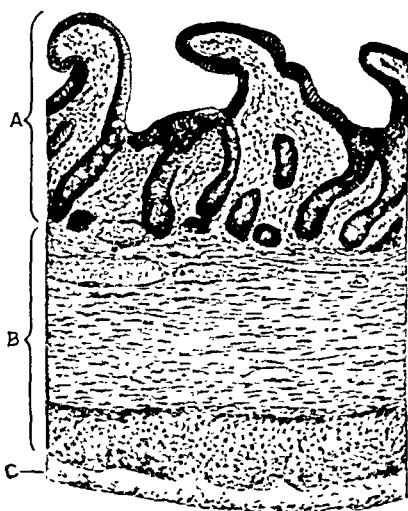


FIG. 399.—Microscopic section from the diverticulum. A, Mucous membrane; B, Muscle; C, Peritoneum.

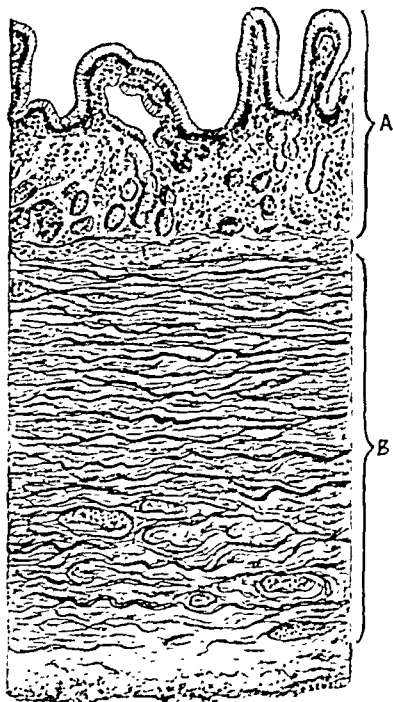


FIG. 400.—Microscopic section from the diverticulum. A, Mucous membrane; B, Atrophy of muscle, with marked increase of fibrous tissue.

Microscopical examination of the appendix showed no definite abnormality. The cicatrix and adhesions in the neighbourhood of the thickened mesentery suggest a local peritonitis, which probably occurred when the patient was taken ill with fever and pain five or six years ago.

Fig. 398 shows the diverticulum opened from behind, and the distal 'valve', and *Figs. 399* and *400* one section through the normal wall and one through the scar tissue of the sac.

The question arises as to the nature of the diverticulum. The history of discomfort early in life suggests its presence at an early period. The fact that the whole of it consists of all coats of the intestine and not a herniation of the mucous membrane proves it to be of congenital origin.

The site of a Meckel's diverticulum varies with the age of the individual, but in an adult occurs at a distance of from 1 to 4 feet from the ileocecal

valve, most usually at about 24 in. from this point. In length it is commonly less than 4 in., the maximum length being 10 in. (Rokitansky), though a diverticulum of the small intestine 36 in. long has been described (Bilton Pollard's case). The diameter, when not represented by a fibrous cord, may be anything up to that of the ileum to which it is attached. The distal end may be free or attached to adjacent gut, mesentery, or to the umbilicus, and occasionally has small herniations. Rarely it is represented by a cyst in the wall of the gut, and may give rise to an intussusception. It is attached to the periphery of the intestine, rarely to the mesenteric border, and often has a mesentery arising from the anterior aspect of the meso-ileum. Occasionally a valve is present at its junction with the small intestine.

The shape of Meckel's diverticulum is variable; of 93 specimens studied by Sir Arthur Keith, 30 were sausage-shaped, 23 vermiform, 13 filiform, 12 saccular, 9 conical, 3 hemispherical, and 3 vestigial. Of these, 12 had secondary sacculations. The thickness of its wall is usually that of the normal ileum.

It will be seen that the diverticulum described differs from the foregoing particulars as follows: It is in the nature of a local dilatation of the long axis of the intestine, and most marked at the periphery of the latter. It is of abnormally large size, and there is the unusual presence of some stenosis at its distal end caused partly by a diminution of the peripheral measurement of the ileum here, and partly by the valve-like arrangement of the mucous membrane. The site of it agrees with that most commonly accepted for a 'Meckel'. This and the fact that stenosis is present at its distal part points to the probability of a developmental error. It is unlikely that the sac is purely the mechanical result of the stenosis; the dilatation and hypertrophy would almost certainly involve a much longer portion of small intestine, and it has been shown experimentally that pressure produces multiple diverticula, whereas this is single.

The other possibility is that the sac represents the duet plus the yolk-sac. No such instance could be found recorded in the literature. If this were the case, the yolk-sac would have been withdrawn into the cœlomic cavity during early fœtal life, and this would be supported by the fact that no cord could be traced to the umbilicus; whereas if the yolk-sac were partly represented, it ought to have a fibrous projection; this is not the case, two herniations alone being present. This view must be considered as a very unlikely probability, and it must be assumed, therefore, that the sac represents a very much dilated and hypertrophied Meckel's diverticulum.

The specimen is now preserved in the Teratological Section of the Museum of the Royal College of Surgeons.

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INTUSSUSCEPTION OF THE APPENDIX.

By G. P. B. HUDDY, BIRMINGHAM.

A MALE, age 39 years, was admitted to the Dudley Road Hospital, Birmingham on July 2, 1926.

HISTORY.—During the years 1918 and 1919 he had suffered from recurrent short attacks of 'stomach-ache' occurring at intervals of about six months. He was then free from symptoms until 1922, when he had an attack similar to the present one. Three weeks before admission he experienced short attacks of pain in the epigastrium and right iliac fossa, coming on particularly about one and a half hours after meals and at 2 a.m. The pain interfered with the movements of the right leg. There had been no vomiting; the bowels had been rather constipated, but neither blood nor mucus had been noticed in the stools.

ON EXAMINATION.—The temperature and pulse were normal. There was tenderness in the right iliac fossa, but no rigidity and no lump. Rectal examination revealed no abnormality.

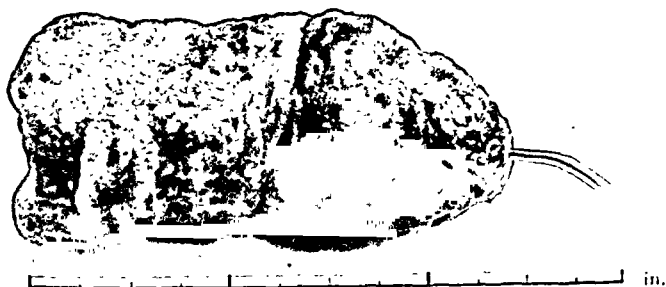


FIG. 401.—Shows probe inserted into the lumen of the appendix at the apex of the intussusception.

OPERATION.—The abdomen was opened through a gridiron incision. When the cæcum was delivered into the wound an elongated mass was felt within it about the size of an adult index finger, and the cæcal wall was freely movable over it. No trace of the appendix could be seen, but at the junction of the three tæniæ coli there was a small depression. A diagnosis of intussusception of the appendix was made and an attempt at reduction failed. The cæcum was opened and the projecting mass removed with a small collar of cæcal wall around it.

There were no complications during convalescence and the wound healed soundly.

The condition is illustrated in *Figs. 401, 402*. *Fig. 401* shows the mucosal aspect, and it will be seen that the mucous membrane of the distal end is

neerotic and sharply demarcated from the healthy portion. On section there was marked muscular hypertrophy of the appendix wall.

McKidd¹ recorded a case as long ago as 1858. In 1911 Battle and Corner² succeeded in finding the records of 29 cases, and a specimen in the Royal College of Surgeons Museum of an unpublished case makes a total of 30. In 1922 Szenes³ reviewed the subject very fully and found 58 examples, but he appears to have overlooked those noted by Treves,⁴ Johnson,⁵ and MacLennan.⁶ Since the publication of his paper further cases have been recorded by Evans,⁷ Hipsley,⁸ Brin and Fruchaud-Brin,⁹ Huese,¹⁰ Trinei,¹¹ McIntosh,¹² and Do Couto.¹³

Szenes adopted the following classification :—

	CASES
1. Invagination of the appendix into itself	1
2. Total or partial invagination into the cæcum	2
a. Without involvement of the cæcal wall	17
b. With involvement of the cæcal wall	28
3. Intussusception carried into the ileum, colon, or further	2
4. Cæcal invagination with commencing invagination of the appendix	1
5. Intussusception with spontaneous reduction	

In 7 cases the description was insufficient to permit of classification.

The age incidence in the case described above is somewhat exceptional, as by far the greater number of cases arise in young children. In those occurring in older people it is not particularly common in any one decade, and may occur in old age, as in the example recorded by Brin and Fruchaud-Brin⁹ in a male of 65 years. Battle and Corner² pointed out that the age incidence was as a rule considerably below that of appendicitis and so did not regard this latter condition as an etiological factor. Dodds Parker¹⁴ found an ascaris in the rectum and he considered this an etiological factor. McKidd¹ noted the presence of worms in the bowel in the case he recorded, and again Holmeier¹⁵ attributed his case to an ascaris worm, and suggested on account of the age incidence that this might be of importance.

Clinically there are two stages. The first is that of invagination of the appendix into itself or into the wide lumen of the cæcum, without any resulting intestinal obstruction. Later this mass acts as a foreign body and is carried forward, dragging the cæcum and later the ileo-cæcal valve into the colon. During the first stage the condition is chronic or at most subacute, and the clinical features are illustrated by the case already described. Vomiting, wasting, and the presence of blood in the stools

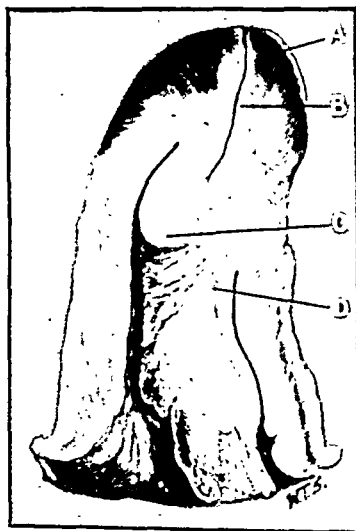


FIG. 402.—A, Necrotic tissue of apex of intussusception; B, Lumen of appendix; C, Tip of invaginated appendix; D, Meso-appendix.

may also be noted. In the second stage the condition simulates the ordinary acute intussusception.

Treatment varies with the pathological condition found. In the first group, as classified by Szenes, simple appendicectomy is required. In the second group reduction of the inverted appendix usually fails, and instead of a simple appendicectomy it then becomes necessary to open the cæcum and resect the appendix with, if necessary, a collar of cæcal wall around it. If the appendix has been carried forward into the colon, this secondary condition must be dealt with on the lines of an ordinary intussusception and by manipulation converted into the second group and treated accordingly, unless on account of some complication, such as gangrene, it is necessary to resect the mass.

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**CERTAIN CHEMICAL CHANGES ASSOCIATED WITH
GALL-STONES,
WITH SPECIAL REFERENCE TO THE RELATION BETWEEN
GALL-STONES AND HYPERCHOLESTEROLÆMIA.***

BY FRANK SCOTT FOWWEATHER AND GEORGE ARTHUR COLLINSON,
LEEDS.

IN spite of the very considerable volume of work which in recent years has been carried out in relation to cholelithiasis, there is still much that remains obscure with regard to this subject. The recent summary given by Wells,¹ for instance, reveals considerable diversity both of evidence and of conclusions, and leaves behind the impression that nothing is known with anything approaching certainty either of the etiology of the disease or of the mechanisms operating to produce its striking and interesting results.

Among the most intriguing of the problems presented by the study of this disease is that which concerns its relationship to hypercholesterolæmia. That considerable attention should be focused on the cholesterol content of the blood is not surprising, since cholesterol forms the greater part of nearly all gall-stones. It seems somewhat strange, however, that more attention has not been paid to the part played by calcium, since this too is present in practically all gall-stones, for even the 'pure cholesterol stone' is generally not without a trace of this element. Other problems of no less interest arise in connection with this disease, and urge the biochemist to add further investigations to those already made.

It seems to us that any investigation which makes an effort towards completeness must include within its scope not only the blood but also the bile, the stones, and the gall-bladder itself, and it is desirable to know not only how much cholesterol each contains but also how much calcium. It is with such an investigation and its results that we propose to concern ourselves in the present communication, and from our own and other workers' observations we offer certain suggestions bearing on some of the problems of this disease.

COLLECTION AND PREPARATION OF THE MATERIAL.

The material used throughout this investigation has been obtained from patients under the care of Sir Berkeley Moynihan. Specimens of blood were obtained within a day or two prior to operation, and, in certain cases to be described later, at an interval of six to twelve months after operation. The

* From the Clinic of Sir Berkeley Moynihan.

rest of the material consisted of the gall-bladders, with the contained bile and stones, which were removed at operation. These were placed under sterile conditions into sterilized receptacles, and sent as soon as possible to the laboratory, where they were opened and the gall-bladder and its contents separated. Specimens from the gall-bladder wall and from the bile were reserved for bacteriological examination, while from the remainder portions were used for chemical analysis, the stones also being used for the same purpose. The preparation of these materials for chemical analysis was as follows :—

Gall-bladder.—Boyd,² in his interesting work on the gall-bladder, stripped the mucous membrane from the rest of the organ and used this for his observations. In many of our cases changes in the mucous membrane by long-standing disease rendered its separation impossible, and it was considered advisable, in order to have uniform conditions throughout, to take the whole thickness of the gall-bladder wall for analysis, removing only fatty deposits and adventitious tissue. Any bile adhering to it was removed by washing in cold running water, after which the tissue was dried quickly on filter-paper but not pressed. Two portions from the same part of the gall-bladder, each about one inch square, were removed and separately weighed. One portion was at once used for cholesterol estimation, and the other was dried to constant weight in the steam oven, after which it was used for calcium estimation. By means of the drying process data were obtained which enabled us to calculate all results as a percentage of *dry tissue* present, thus eliminating the disturbing effects on the results due to a widely different water content of different specimens.

Bile.—Immediately after removal of the bile from the gall-bladder it was centrifugalized to remove suspended material, and the clear supernatant fluid used for analysis. In cases where the bile was too viscid for satisfactory centrifugalization or accurate measurement of small quantities, it was first diluted in bulk in a known ratio with distilled water, and the clear diluted liquid used for analysis.

Stones.—These were thoroughly washed in cold running water, dried with filter paper, and preserved in cotton-wool to be analysed when convenient.

METHODS OF ANALYSIS.

1. Estimation of Cholesterol.—

a. In Blood.—For this estimation we have employed the method of Myers and Wardell,³ using standard solutions of pure cholesterol in chloroform for colorimetric comparison. By this method 'total' cholesterol is estimated—i.e., both free cholesterol and cholesterol present as esters.

b. In Tissue.—The piece of tissue selected for analysis was cut up into very small pieces and thoroughly ground with 3 to 4 gm. of plaster-of-Paris in a glass mortar. The mixture was then dried and extracted as in Myers and Wardell's method for blood.

c. In Bile.—The essential features of the method used for blood were retained, but a modification had to be introduced owing to the fact that the pigments of heated bile are soluble in chloroform, so that their presence in the chloroform extract renders the colour developed from the cholesterol unsuitable for satisfactory comparison. The pigments can be fixed as sodium salts, which are insoluble in chloroform, by the addition of a little caustic soda. Accordingly a measured quantity of bile was mixed with an equal volume of dilute (approximately normal) caustic soda solution, and the determination of cholesterol was made on 1 c.c. of this mixture, by the method used for blood.

d. In Stones.—The stones were finely powdered and extracted in a modified Soxhlet apparatus with chloroform. The solvent was evaporated from the extract, and the amount of cholesterol determined by direct weighing of the residue. Strictly speaking, the residue does not consist wholly of cholesterol, but the amount of other chloroform-soluble substances in gall-stones is relatively so small as to leave our results sufficiently accurate for our present purpose.

2. Estimation of Calcium.—

a. In Blood.—For this purpose we have employed the method of Kramer and Tisdall,⁴ using plasma obtained from blood to which a little solid sodium citrate had been added.

b. In Tissue.—The tissue selected for analysis was thoroughly dried in the steam oven and the proportion of dry matter present was determined. The dry tissue, in a small porcelain crucible, was then carefully ignited, using a blow-pipe if necessary to remove all traces of carbon. After cooling, any white residue which had adhered to the sides of the crucible was washed down with a very fine jet of water from a wash-bottle. The total washings were not allowed to exceed 2 c.c.; 0.5 c.c. of hydrochloric acid (1-3) was then added, and the crucible allowed to stand for a few minutes to permit of complete solution of the calcium salts of the residue. A drop of litmus solution was then added, and strong ammonia solution from a teat pipette, a drop at a time, until the liquid became alkaline. This liquid was then washed into a 10-c.c. graduated centrifuge tube until the total volume was about 6 c.c. From this point onward the estimation was proceeded with as in the case of blood-plasma.

c. In Bile.—For this estimation the method used for blood was followed, with one modification. It was found that the addition to bile of ammonium oxalate caused the precipitation of some organic matter, oxidizable by permanganate, in addition to calcium oxalate. This organic matter is not soluble in dilute sulphuric acid. Hence, after dissolving the calcium oxalate precipitate in the acid, the residue of organic matter was collected at the bottom of a centrifuge tube by centrifugalization and the supernatant fluid removed from it by decantation, before being titrated with permanganate. By this method results were obtained which agreed well with those given by the sound but laborious method of ignition.

d. In Stones.—The method employed was similar to that described for tissue, namely, the ignition of a weighed quantity of the powdered stone with

solution of the residue in hydrochloric acid and determination of the calcium in solution by means of permanganate.

Normal Standards.—The normal range for cholesterol and calcium in the blood has been already established. In order to obtain values for these substances in the bile and gall-bladder wall we selected material from the post-mortem room from healthy subjects who had died suddenly as the result of street accidents, and on whom the post-mortem examination was made within three or four hours after death. Only material from persons who in the pathologist's opinion were quite healthy at the time of the accident was accepted. The limitations imposed made the number of suitable cases very small, but the results obtained lie within such narrow limits that they probably form a sufficiently satisfactory standard for comparison with those obtained from pathological cases, many of which differed very considerably from the standards obtained. The results are shown in *Table I.*

Table I.—NORMAL GALL-BLADDERS.

POST-MORTEM NUMBER	CALCIUM IN G.-B. WALL		CHOLESTEROL IN G.-B. WALL		BILE	
	Wet	Dry	Wet	Dry	Calcium	Cholesterol
	Mgms. per 100 grm.	Mgms. per 100 grm.	Per cent	Per cent	Mgms. per 100 c.c.	Per cent
211-25	30.5	153	0.206	1.03	21.0	0.21
212-25	23.0	117	0.194	0.97	20.0	0.20
378-25	27.0	109	0.193	0.77	—	—
814-25	31.0	140	0.190	0.85	14.2	0.24
140-26	26.0	101	0.200	0.79	19.2	0.28
152-26	23.0	118	0.200	1.07	—	—
339-26	20.5	104	0.180	0.91	27.0	0.23
<i>Range ..</i>	20.5 to 30.5	101 to 153	0.180 to 0.206	0.77 to 1.07	14.2 to 27	0.20 to 0.28
<i>Mean ..</i>	25	120	0.195	0.91	20	0.23

RESULTS IN 81 CASES OF CHOLECYSTECTOMY.

In drawing up our results in these cases we have introduced signs to indicate at once to the reader the significance of the result obtained—whether normal, increased, or diminished—instead of actual figures. The range obtained and the mean with respect to each set of figures is given in each section of *Table II.* The table has been subdivided into sections according to the type of result obtained for the blood cholesterol, as this seems to be the best way of indicating the relationship between blood-cholesterol findings

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and other changes which were found to accompany the presence of gall-stones. The meaning of the signs employed is as follows :—

Blood	CALCIUM (mgrm. per 100 c.c.)	CHOLESTEROL (per cent)
N = Normal	9-11	0.13-0.16
N+ = High normal	11-11.5	0.16-0.19
- = Raised	Over 11.5	0.20-0.24
-+ = Very high	—	Over 0.24
N- = Low normal	8.6-9	0.11-0.13
- = Diminished	Less than 8.6	—

Gall-bladder Wall	CALCIUM (mgrm. per 100 gm. dry tissue)	CHOLESTEROL (percentage dry tissue)
N	100-120	0.90-1.05
N+	120-160	1.05-1.10
+	160-200	1.10-1.30
++	Over 200	Over 1.30
N-	70-100	0.80-0.90
-	Less than 70	Less than 0.80

Bile	CALCIUM (mgrm. per 100 c.c.)	CHOLESTEROL (per cent)
N	18-28	0.19-0.22
N+	28-35	0.22-0.30
+	Over 35	0.30-0.35
++	—	Over 0.35
N-	12-18	0.15-0.19
-	Less than 12	Less than 0.15

The last column of the table contains data regarding the stones found in the gall-bladder. The results of bacteriological examination of bile and gall-bladder wall are also given, together with any special information noted regarding the condition of the gall-bladder. Brief notes of the patient's history have also been added. In the different sections of the table we have separated from the rest those cases in which, owing to complete occlusion of the cystic duct, 'white bile' has been produced, since, so far as the composition of the gall-bladder fluid is concerned, these must necessarily differ from those cases in which the bile reservoir has not been cut off from its source of supply.

It was not possible to obtain analytical data for every member of the system in every case. In some instances, for example, the quantity of bile present in the gall-bladder was insufficient for analysis. In the majority of cases, however, full data have been obtained.

Table II.—RESULTS IN 81 CASES OF CHOLECYSTECTOMY.

A. Blood-cholesterol $\pm \pm$ = 0.246 per cent to 0.499 per cent.
Mean = 0.296 per cent.

NUMBER, AGE & SEX	CHOLESTEROL		CALCIUM			REMARKS
	G.B.	Bile	Blood	G.B.	Bile	
Cases with pigmented bile--						
4 69-M	N	..	N	++	..	One large stone filling a shrivelled bladder. Calcium 3.24 per cent, cholesterol 78 per cent; <i>copper present</i> in stone. Jaundice at operation. Long history
7 59-F	..	N	..	++	N-	No stones. Bile and gall-bladder sterile. Frequent attacks; 3 years' history.
11 44-M	-	..	+	N	..	Two mulberry stones. Calcium 0.03 per cent, cholesterol 91 per cent. Also 7 small stones. Bile and bladder sterile. 4 attacks in 2½ years
12 64-M	++	..	+	N+	..	Six small stones. Calcium 1.0 per cent, cholesterol 68 per cent, and <i>trace of copper</i> . Small shrunken bladder. Bile and bladder — <i>B. coli</i> . 2 years' history
41 53-F	+	+	N	+	N	One large stone. Calcium 3.6 per cent, cholesterol 61 per cent. Bile and gall-bladder sterile. Short history
53 42-F	N+	-	+	++	-	Nine large faceted stones. Calcium trace, cholesterol 81 per cent. Bladder large and distended. Bile and bladder— <i>B. coli</i> . 1 year's history
55 41-F	++	+-	N	++	N	No stones. Adhesions round gall-bladder. Gastro-enterostomy 3½ years ago
59 ?-F	N	++	N	N-	-	No stones. Strawberry gall-bladder, much inflamed. Bile and bladder sterile. Stone removed 3 years ago, followed by recurrence of symptoms.
62 ?-F	++	N+	+	+	N	No stones. Bladder very fatty. Bile and bladder sterile. Long history of frequent attacks
69 45-F	++	..	-	N	..	One large pigmented stone and one small faceted. Calcium 0.9 per cent, cholesterol 68 per cent. Jaundice at operation. Bile and bladder— <i>B. coli</i> . Short history; frequent attacks

	Per cent	Per cent	Mg. per 100 c.c.	Mg. per 100 g.	Mg. per 100 c.c.
Range	0.72 to 2.48	0.12 to 0.54	8.1 to 13.1	80 to 309	9.2 to 24.1
Mean	1.42	0.32	10.8	183	15.4

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NUMBER, AGE & SEX	CHOLESTEROL		CALCIUM			REMARKS
	G.B.	Bile	Blood	G.B.	Bile	

Summary of 10 cases with pigmented bile—

++	4	2	..	4	..
+	1	1	4	2	..
N+	1	2	..	1	..
N	2	..	4	2	3
N—	..	..	..	1	1
—	1	1	1	..	2
Not deter- mined	1	4	1	..	4

Cases with 'white bile'—

24 56-F	N+	—	..	+	—
72 ?—F	—	..	N+	—	..
73 46-F	—	—	+	N	—

No stones in bladder. Bile sterile. Bladder — *B. coli* and staphylococcus. Frequent attacks; short history

Many stones. Calcium trace, cholesterol 83 per cent. Bile and bladder — *B. coli*. Long history.

Many stones. Calcium 0.6 per cent, cholesterol 70 per cent. Bladder inflamed. Bile and bladder "pure growth of a coccobacillus with tendency to form bizarre bacillary forms". 2 years' history.

	Per cent	Per cent	Mg. per 100 c.c.	Mg. per 100 g.	Mg. per 100 c.c.
Range	0.57 to 1.13	trace to 0.07	11.4 to 13.1	40 to 194	6 to 10
Mean	0.83	..	12.2	115	8

Summary of 3 cases with 'white bile'—

++
+	..	..	1	1	..
N+	1	..	1	..	..
N	..	..	..	1	..
N—	..	..	..	..	..
—	2	2	..	1	2
Not deter- mined	..	1	1	..	..

B. Blood-cholesterol + = 0.195 per cent to 0.240 per cent.
Mean = 0.213 per cent.

NUMBER, AGE & SEX	CHOLESTEROL		CALCIUM			REMARKS
	G.B.	Bile	Blood	G.B.	Bile	
Cases with pigmented bile—						
1 58-F	+	—	..	++	N—	One large stone. Calcium 8.6 per cent, cholesterol 51 per cent. Many smaller stones. Calcium 2.2 per cent, cholesterol 72 per cent. Bladder thickened. Bile and bladder— <i>B. coli</i> . 4 years' history
6 48-F	N	++	N—	+	N	One stone. Calcium 0.2 per cent, cholesterol 78 per cent. Bile and bladder sterile. Indefinite history over long period
8 ?—F	++	N—	..	++	N—	Many small stones. Calcium 0.4 per cent, cholesterol 76 per cent. Bile and bladder— <i>B. coli</i> . Bladder inflamed. 3 years' history
13 52-F	—	++	—	N+	N	No stones, much sandy sediment. Bile and bladder— <i>B. coli</i> . Long history; previous drainage of gall-bladder
16 64-M	—	..	+	N+	..	No stones, some sandy sediment. Bladder small and shrunken. Bile and bladder sterile. Short history. Jaundice at operation
29 44-F	—	++	+	—	—	No stones. Bile sterile. Bladder— <i>St. albus</i> . Bladder adherent. Short history
30 50-F	N	++	N	—	N—	Two large stones. Calcium 0.03 per cent, cholesterol 90 per cent. Bile and bladder sterile. Long history
36 27-F	N	N+	+	+	N	One large stone. Calcium trace, cholesterol 94 per cent. Bile and bladder sterile. Short history
46 81-M	N—	N+	N	N	N—	Three round and many faceted stones. Calcium 0.9 per cent, cholesterol 71 per cent. Bile and bladder sterile. Bladder thickened and scarred
50 53-F	+	N+	+	N+	..	No stones. Bile and bladder— <i>B. coli</i> . Bladder lying in mass of adhesions. 2 years' history; recent severe attack
56 51-F	++	N	..	N+	N	Stone in cystic duct. Bile and bladder sterile. Bladder surrounded by adhesions. Short history; recent attack
57 45-F	N	N—	N	N+	N	Many stones. Calcium 11 per cent, cholesterol 40 per cent. Bile and bladder—non-hæmolytic streptococcus probably of fecal type. Long history
60 54-M	N—	++	N	+	N	One large stone. Calcium 2.1 per cent, cholesterol 76 per cent. Bile and bladder sterile. Bladder adherent to duodenum. Long history
61 ?—F	+	N+	N—	N	N	Twenty-five small black stones. Calcium 12 per cent, cholesterol 54 per cent. Bile and bladder sterile. Long history
63 43-F	++	..	N	N—	..	Many small stones. Calcium 0.3 per cent, cholesterol 78 per cent. Bile and bladder—non-hæmolytic streptococcus. Bladder small and thickened. Long history
66 ?—F	+	++	+	N	..	One stone. Calcium 0.1 per cent, cholesterol 84 per cent. Bile sterile. Bladder—one isolated colony of <i>St. aureus</i> . Typhoid 5 years ago

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NUMBER, AGE & SEX	CHOLESTEROL		CALCIUM			REMARKS
	G.B.	Bile	Blood	G.B.	Bile	
	Per cent	Per cent	Mg. per 100 c.c.	Mg. per 100 g.	Mg. per 100 c.c.	
Range	0·62 to 1·51	0·11 to 1·0	8·6 to 13·1	40 to 289	10·6 to 24·0	
Mean	1·03	0·36	10·9	137	18·5	

Summary of 16 cases with pigmented bile—

++	3	6	..	2	..
+	4	..	5	3	..
N+	..	4	..	5	..
N	4	1	5	3	7
N-	2	2	2	1	4
-	3	1	..	2	1
Not determined	..	2	4	..	4

Cases with 'white bile'—

14 44-M	N	-	..	N-	N-	One small stone. Calcium 0·5 per cent, cholesterol 76 per cent. Bile sterile. Bladder—one colony of <i>St. albus</i> . Stone in cystic duct. Short history
25 50-F	-	-	N	N	-	One stone. Calcium trace, cholesterol 84 per cent. Bile and bladder— <i>St. aureus</i> . Previous operation, leaving fistula to skin
34 30-F	+	-	N	N+	-	Two large and 7 small stones. Calcium 2 per cent, cholesterol 73 per cent. Bile sterile. Bladder—a few colonies of a diphtheroid bacillus. 5 years' history
45 2-F	-	-	+	+	N-	Seven stones. Calcium 0·1 per cent, cholesterol 63 per cent. Bile and bladder sterile. 8 years' history
54 2-M	N-	-	N	N+	-	Twenty-two small black stones. Calcium 16 per cent, cholesterol 6 per cent. Bile—profuse growth of <i>B. coli</i> and few colonies of non-haemolytic streptococci. Bladder— <i>B. coli</i> . Long history
68 2-M	-	-	N+	N-	N-	One large stone impacted in cystic duct. Calcium 4·6 per cent, cholesterol 48 per cent. Bile and bladder sterile. Long history

	Per cent	Per cent	Mg. per 100 c.c.	Mg. per 100 g.	Mg. per 100 c.c.
Range	0·33 to 1·29	0·05 to 0·13	10·2 to 11·6	98 to 181	2·8 to 15·0
Mean	0·79	0·08	10·96	136	10·3

Summary of 6 cases with 'white bile'—

++
+	1	..	1	1	..
N+	1	..	1	3	..
N	1	..	3	1	..
N-	..	..	..	1	3
-	3	6	..	..	3
Not determined	..	..	1	..	..

C. Blood-cholesterol $N\pm = 0.162$ per cent to 0.190 per cent.
Mean = 0.179 per cent.

NUMBER, AGE & SEX	CHOLESTEROL		CALCIUM			REMARKS
	G.B.	Bile	Blood	G.B.	Bile	
5 61-F	++	++	..	++	N	One large stone in which some cotton fibres were embedded. Calcium 6.4 per cent, cholesterol 46 per cent. Bile and bladder sterile.
15 35-F	++	N+	N	N+	—	About 100 hard black stones. Calcium 33.4 per cent, cholesterol 1.4 per cent. Bile and bladder sterile. 1 year's history; frequent attacks
21 45-M	..	..	N	++	..	Many stones—not analysed. Bile—numerous colonies of <i>St. aureus</i> . Bladder— <i>St. aureus</i> and a hæmolytic non-fæcal streptococcus. Jaundice at operation. Short history
22 55-F	—	++	+	++	N—	Thirty-four fairly large stones. Calcium 1.2 per cent, cholesterol 71 per cent. Bile and bladder— <i>St. albus</i> . 2 to 3 years' history
28 33-F	—	..	N	++	..	Single mulberry stone. Calcium 0.1 per cent, cholesterol 94 per cent. Bladder small and shrunken, with surrounding adhesions. Bile and bladder sterile. Indefinite, long history
51 59-F	++	..	N	++	..	Single stone. Calcium 2.5 per cent, cholesterol 63 per cent. Bile and bladder— <i>B. typhosus</i> . Indefinite, long history
65 43-M	—	..	N	N—	..	No stones. Bile—a few colonies of <i>St. albus</i> . Bladder sterile. At operation large duodenal ulcer found with many adhesions burying the gall-bladder. Long history
67 ?-M	—	++	N+	—	N—	Numerous small stones. Calcium trace, cholesterol 80 per cent. Bile and bladder sterile. Long history
Range	Per cent	Per cent	Mg. per 100 c.c.	Mg. per 100 g.	Mg. per 100 c.c.	
	0.45 to 1.45	0.25 to 0.46	9.5 to 13.2	60 to 330	12.2 to 22.4	
Mean	0.94	0.38	10.9	185	15.9	

Summary—

++	3	3	..	5	..
+	..	..	1	..	..
N+	..	1	1	1	..
N	..	..	5	..	1
N—	..	..	..	1	2
—	4	..	..	1	1
Not determined	1	4	1	..	4

D. Blood-cholesterol N = 0.130 to 0.160.
Mean = 0.144.

NUMBER, AGE & SEX	CHOLESTEROL		CALCIUM			REMARKS
	G.B.	Bile	Blood	G.B.	Bile	
9 60-F	N	N+	+	N+	N	Single stone. Calcium 1.4 per cent, cholesterol 76 per cent. Bile and bladder—faecal streptococci. Cholecystotomy 8 years ago
10 46-F	+	++	..	+	N-	Nine small stones. Calcium 0.2 per cent, cholesterol 91 per cent. Bile and bladder sterile. Very recent history
17 50-F	N-	+	N	N+	N-	No stones, some sediment. Bile and bladder sterile. 1½ years' history; frequent attacks
18 32-F	N	++	+	++	N	Three large mulberry stones. Calcium 0.12 per cent, cholesterol 87 per cent. Bladder sterile. Bile not examined. 8 years' history
19 67-M	N-	..	+	++	..	One stone in common duct—not analysed. Bladder— <i>B. coli</i> and a non-haemolytic faecal streptococcus. Bile not examined. Bladder dry and shrunken. Long history
20 37-M	N	N	..	+	N-	Many small stones. Calcium 0.05 per cent, cholesterol 89 per cent. Bile and bladder sterile. Short history
23 59-M	-	..	+	+	..	Three large and 9 smaller stones. Calcium 1.9 per cent, cholesterol 30 per cent, and trace of copper. Bile and bladder— <i>B. coli</i> and non-haemolytic streptococci. Small bladder with fistula into colon. Long history
27 52-M	N	++	N	N+	+	Two enormous stones. Calcium 2.1 per cent, cholesterol 60 per cent. Bile and bladder sterile. 8 years' history
31 60-M	-	N+	..	N-	N-	Five large and many small stones. Calcium trace, cholesterol 85 per cent. Bile and bladder sterile. Bladder fibrosed. 1 year's history
32 65-M	++	N	+	N	N-	Ten small stones. Calcium trace, cholesterol 91 per cent. Bladder large and inflamed
33 60-M	+	..	N	N+	..	One large stone. Calcium 0.5 per cent, cholesterol 76 per cent. Bile and bladder—non-haemolytic streptococci. Bladder thickened, with ulceration. Long history
37 44-F	+	N+	N	N+	-	No stones. Bile and bladder sterile. Bladder adherent to duodenum. Long, indefinite history
38 41-F	N-	N+	+	N	-	Ten small stones. Calcium 0.1 per cent, cholesterol 81 per cent. Bile and bladder sterile. Long, indefinite history
39 60-F	++	+	N	++	N	One stone. Calcium 7.3 per cent, cholesterol 43 per cent, and some sandy sediment. Bile and bladder sterile. Bladder thickened. 2 years' history
40 60-F	N	N-	N	N	..	Two small black stones. Calcium 1.2 per cent, cholesterol 68 per cent. Bile and bladder— <i>B. coli</i> . Bladder small, fibrosed. Operation for gall-stones 10 years ago
43 42-F	++	++	N	N	+	Many small stones. Calcium trace, cholesterol 80 per cent. Bile and bladder sterile. Slight lipoid stippling of mucosa. 3 years' history

NUMBER, AGE & SEX	CHOLESTEROL		CALCIUM			REMARKS
	G.B.	Bile	Blood	G.B.	Bile	
44 42-F	N-	++	N	++	+	Thirty-eight small stones. Calcium 3 per cent, cholesterol 63 per cent. Bile and bladder sterile. Bladder inflamed. Indefinite history for 2½ years
47 32-F	N-	..	N+	++	..	Fifty small stones. Calcium 0.04 per cent, cholesterol 7.4 per cent. 5½ years' history
49 39-F	++	N-	N	+	-	Twenty small stones. Calcium 16 per cent, cholesterol 6 per cent. Bile and bladder— <i>B. coli</i> . Bladder mucosa atrophic and granular
58 55-M	++	N-	..	..	N-	Nine fairly large and 30 smaller stones. Calcium 0.1 per cent, cholesterol 82 per cent. Bile and bladder sterile. 3 years' history
64 41-F	-	..	N	-	..	No stones. Bile and bladder— <i>B. coli</i> . Bladder small, white, adherent. 2 years' history
75 52-M	-	..	N+	++	..	Single stone. Calcium 25.0 per cent, cholesterol 9 per cent. Bladder much fibrosed
76 60-M	-	..	N	N	..	Single stone. Calcium 0.5 per cent, cholesterol 86 per cent. Bladder inflamed
78 57-F	++	N+	..	-	N-	No stones. Lipoid deposits in bladder wall
79 53-F	++	++	N	N	N-	One large stone. Bile and bladder sterile
81 31-F	N	..	..	N+	..	No stones. Bile and bladder sterile

	Per cent	Per cent	Mg. per 100 c.c.	Mg. per 100 g.	Mg. per 100 c.c.
Range	0.47 to 4.43	0.15 to 1.79	9.1 to 13.2	33 to 339	10.3 to 43.0
Mean	1.22	0.43	10.9	159	18.5

Summary of cases with pigmented bile—

++	7	6	..	6	..
+	3	2	6	4	3
N+	..	5	2	7	..
N	6	2	12	6	3
N-	5	3	..	..	8
-	5	..	..	2	3
Not determined	..	8	6	1	9

Cases with 'white bile'—

26 62-M	N+	-	+	N-	-	One large stone with 3 distinct layers, viz.: core, calcium 0.6 per cent, cholesterol 82 per cent; middle, calcium 2.3 per cent, cholesterol 56 per cent; outer, calcium 0.2 per cent, cholesterol 85 per cent. Bile and bladder— <i>B. coli</i>
35 51-F	-	..	N	-	..	One large stone. Calcium 0.15 per cent, cholesterol 88 per cent. One smaller stone. Bile— <i>B. coli</i> . Bladder sterile. 1 year's history

	Per cent	Per cent	Mg. per 100 c.c.	Mg. per 100 g.	Mg. per 100 c.c.
Range	0.50 to 1.10	trace to 9.2	9.2 to 13.8	72 to 80	trace

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E. Blood-cholesterol N- = 0.111 per cent to 0.120 per cent.
Mean = 0.118 per cent.

NUMBER, AGE & SEX	CHOLESTEROL		CALCIUM			REMARKS
	G.B.	Bile	Blood	G.B.	Bile	
42 60-M	—	N	N	N+	N—	No stones. Some black gritty deposit. Bile— <i>B. coli</i> . Bladder— <i>B. coli</i> , a few colonies of <i>St. albus</i> . Long indefinite history
71 47-F	—	N+	..	N+	N—	Many small black stones. Calcium 11 per cent, cholesterol 40 per cent. Bile and bladder sterile. Bladder thickened. Long, indefinite history
74 49-F	++	..	..	+	..	Two stones. Calcium 9.8 per cent, cholesterol 40 per cent. Bile and bladder sterile. 1 year's history
80 33-F	N—	N+	..	N—	..	Single small stone. Calcium trace, cholesterol 80 per cent. Bile and bladder sterile

	Per cent	Per cent	Mg. per 100 c.c.	Mg. per 100 g.	Mg. per 100 c.c.
Range	0.71 to 3.61	0.21 to 0.28	10.8	1.33 to 1.70	17 to 18
Mean	1.47	0.25	—	1.34	17.5

Summary—

++	1	..	..	..	..
+	..	..	..	1	..
N+	..	2	..	2	..
N	..	1	1	..	..
N—	1	..	..	1	2
—	2	..	..	..	..
Not determined	..	1	1	..	2

F. Blood-cholesterol not determined.

NUMBER, AGE & SEX	CHOLESTEROL		CALCIUM			REMARKS
	G.B.	Bile	Blood	G.P.	Bile	
2 ?—F	..	N	..	+	—	No stones. Bladder adherent. Long, indefinite history
3 44-F	+	++	..	+	N	Seventeen stones. Calcium 5.5 per cent, cholesterol 79 per cent. Bladder inflamed. Long, indefinite history
48 ?—F	N—	..	..	++	..	Single stone with calcareous cap. Calcium 35 per cent, cholesterol 15 per cent. Bile and bladder sterile. 2 years' history
52 ?—F	++	++	..	++	N	Two small stones. Calcium 6 per cent, cholesterol 49 per cent. Bile and bladder sterile. Recent history
70 28-F	+	N	..	N+	N—	About 100 small stones. Calcium trace, cholesterol 90 per cent. Bile and bladder sterile. Wall thickened. Recent history
77 45-F	+	—	..	N+	..	Many stones. Calcium 2.6 per cent, cholesterol 45 per cent

It is necessary to bear in mind, when considering the foregoing results, that a perfectly clear-cut picture of the processes at work in the formation of gall-stones is not to be expected. Some patients come for operation after one or a few attacks, and with a comparatively short history. The gall-bladders in such cases are frequently found to show comparatively little change and are probably capable of comparatively normal function. On the other hand, as a result of frequent or severe attacks, or the long-continued presence of stones in the gall-bladder, this organ is sometimes found to consist of little but fibrous tissue whose function must be considerably impaired or almost non-existent. The results obtained by us in such cases, in which one member of the system is not functioning in the normal way, will clearly differ from those in which all members are active, and will differ from the results which would have been obtained in the earlier stages of the disease in these same cases. Further, the history, the indications of the ages of the stones (as shown by the number of separate 'families' or the number of distinct laminæ in individual stones), and the histological examination of the gall-bladder, cannot give us more than a rough idea of the functional capacity of the organ concerned, since neither duration of disease nor apparent structural change bears a close relationship to failure of function. If these limitations are borne in mind, it does seem possible to observe certain definite tendencies from the results shown, and from these to infer what processes are at work. Before considering the results in detail, certain more general information offered by *Table II* may be referred to.

Sex Incidence.—Out of 81 patients 24 (29·6 per cent) were males.

Demonstrable Infection of Bile and Gall-bladder Wall.—Out of 66 cases in which both bile and gall-bladder wall were examined bacteriologically, the findings were as follows :—

Bile and gall-bladder	..	..	..	Negative	..	..	..	38
" " "	..	..	..	<i>B. coli</i>	..	..	..	11
" " "	..	..	..	Non-hæmolytic streptococci	..	..	..	4
" " "	..	..	..	<i>St. aureus</i>	..	..	..	1
" " "	..	..	..	<i>St. albus</i>	..	..	..	1
" " "	..	..	..	<i>B. typhosus</i>	..	..	..	1
" " "	..	..	..	Rare coccobacillus	..	..	..	1
Bile, negative; Gall-bladder, <i>St. albus</i>	..	..	..	..	..	..	..	2
" " " <i>St. aureus</i>	..	..	..	..	..	..	..	1
" " " Diphtheroid bacillus	..	..	..	..	..	..	..	1
" " " <i>B. coli</i> and staphylococci	..	..	..	..	..	..	..	1
Gall-bladder, negative: Bile, <i>St. albus</i>	..	..	..	..	..	..	..	1
Bile, <i>B. coli</i> ; Gall-bladder, <i>B. coli</i> and <i>St. albus</i>	..	..	..	..	..	..	..	1
" <i>B. coli</i> and non-hæmolytic streptococci; Gall-bladder, <i>B. coli</i>	..	..	..	..	..	..	..	1
" <i>St. aureus</i> ; Gall-bladder, <i>St. aureus</i> and hæmolytic streptococci	..	..	..	..	..	..	..	1

Blood Changes.—Of 75 cases in which the blood cholesterol was determined, 35 (46·7 per cent) had definitely raised values, while 8 (10·7 per cent) had high normal values. Only 4 had low normal values, and no case gave values less than 0·11 per cent.

Out of 58 cases in which the blood calcium was determined, 19 (32·8 per cent) had definitely raised values, while 5 (8·6 per cent) had high normal values. Two only had low normal values, while one had a definitely low

value, this being a case in which jaundice was present when the specimen was taken for analysis. Low blood-calcium values are to be expected when jaundice is present, since the bilirubin in the blood probably reacts with some of the calcium present to form the calcium salt of bilirubin, which is insoluble and hence is not present in the plasma used for analysis.

Eleven of the 19 cases with raised blood-calcium occurred amongst the 35 cases with raised blood-cholesterol, while the remaining 8 occurred amongst 36 cases with normal or high normal blood-cholesterol. There is, then, so far as the present series of cases is concerned, a somewhat greater tendency for the blood-calcium to be raised where the cholesterol is also high than where the cholesterol is normal.

Bile Changes.—For reasons already mentioned, cases with 'white bile' require to be considered separately from those with true, pigmented bile. So far as cholesterol content is concerned, of 9 cases of 'white bile' examined, all showed a definitely low value, as would be expected. Of 50 cases of pigmented bile, the following summary indicates the findings:—

CHOLESTEROL	NO. OF CASES	PERCENTAGE OF TOTAL
++	19	38
+	3	6
N+	14	28
N	6	12
N—	5	10
—	3	6

That is, experimental evidence shows undoubtedly that in cases of gall-stones the most frequent variation from the normal in the cholesterol content of the bile, where complete obstruction of the cystic duct is absent, is towards an increased cholesterol concentration.

Turning now to calcium, we find that, of 9 cases of 'white bile' examined, 3 gave low normal, and 6 definitely low values; while in 45 cases of true pigmented bile the results were as follows:—

CALCIUM	NO. OF CASES	PERCENTAGE OF TOTAL
+	3	6.7
N	16	35.5
N—	18	40.0
—	8	17.8

That is, the most frequent variation from the normal is a reduction in calcium concentration.

Changes in the Gall-bladder Wall.—Out of 11 cases with 'white bile', the gall-bladder cholesterol was raised in 1 case, high normal in 3, and definitely low in 6. In 66 cases with pigmented bile, the results were as follows:—

CHOLESTEROL	NO. OF CASES	PERCENTAGE OF TOTAL
++	19	28.8
+	11	16.7
N+	1	1.5
N	12	18.2
N—	8	12.1
—	15	22.7

This table shows 45.5 per cent of cases with definitely raised values and 22.7 per cent with definitely low values, i.e., in cases of gall-stones a very considerable proportion show changes in the cholesterol content of the gall-bladder, and where complete obstruction of the cystic duct is absent there is a greater tendency for increase in cholesterol concentration than for decrease.

When we consider calcium, we find, in the 11 'white bile' cases, 2 with raised values, 2 with lowered values, and 7 within the normal range, whereas in 69 cases with pigmented bile the distribution is :—

CALCIUM	NO. OF CASES	PERCENTAGE OF TOTAL
++	19	27.5
+	12	17.4
N+	18	26.1
N	11	15.9
N—	4	5.8
—	5	7.3

This shows 44.9 per cent of cases with definitely raised values and 7.3 per cent with definitely reduced values ; i.e., in cases of gall-stones a large proportion show definite changes in the calcium content of the gall-bladder wall, and where complete obstruction of the cystic duct is absent the number which show increase is considerably in excess of those which show a decrease.

When we come to consider the different sections of the table separately, the outstanding fact is that in nearly all cases considerable disturbance is found in the composition either of the gall-bladder or of the bile, or of both, and moreover there is no obvious preponderance of such disturbance in any one section of the table ; i.e., in patients with gall-stones, apart from any changes that may be found in the blood cholesterol, there are frequently noticeable changes in the composition of the gall-bladder wall and the bile. That is to say, there is some association between the formation of gall-stones and changes in the chemical composition of the gall-bladder and the bile.

The way in which the different constituents dealt with vary with the blood cholesterol is shown in *Fig. 403*, in which the mean value of the different constituents in each section of *Table II* is plotted against the mean of the blood-cholesterol values for the same section. (Section *E* is not included in this figure, since the results obtained in this section are too few to be of any significance.) The chart shows clearly that even where the blood cholesterol is normal, there are, in general, marked changes in both the bile and the gall-bladder. Further, it shows that changes in the bile calcium are accompanied by changes in the gall-bladder calcium in the opposite direction, and the same reciprocal relationship obtains between the bile cholesterol and the gall-bladder cholesterol for cases with a definitely raised blood cholesterol, though this reciprocal relationship is not in evidence where the blood cholesterol is within fairly normal limits.

An examination of the results of our analyses of the stones obtained from the different cases shows that in each section of the table stones of widely varying composition are found, and there is no very obvious preponderance of any single type of stone in any section of the table. The 'solitary cholesterol gall-stone' is seen to be accompanied by chemical changes in

blood, gall-bladder, and bile quite similar to changes accompanying other types of stones, so that, on chemical grounds, it has no claim to be considered as a distinct and separate entity.

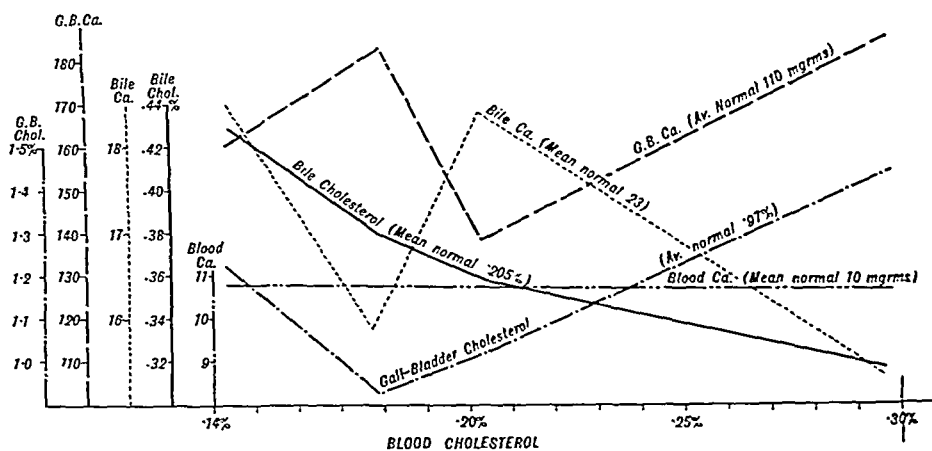


FIG. 403.—Chart showing relation between changes in the gall-bladder-wall and bile and those in the blood cholesterol.

Thus the results of our stone analyses afford us no assistance in the general consideration of our subject. They assume interest, however, when considered with the blood, bile, and gall-bladder findings of individual cases.

Before proceeding to a discussion of the significance of our experimental results, it may be advisable to summarize the indications already obtained.

SUMMARY OF RESULTS.

1. *Blood cholesterol*.—46.7 per cent of cases showed definitely raised values for blood cholesterol.

2. *Blood calcium*.—32.8 per cent of cases showed definitely raised values for blood calcium.

3. *Bile cholesterol*.—44 per cent of cases showed a definitely increased concentration of cholesterol, as against only 6 per cent with a decreased concentration. The mean value throughout was considerably higher than the mean normal value, but decreased with increase in the blood cholesterol.

4. *Bile calcium*.—17.8 per cent of cases showed a definitely decreased calcium concentration, as against 6.7 per cent with increased concentration. The mean value throughout was below the normal mean value, but its variation with increased blood cholesterol was not always in the same direction.

5. *Gall-bladder cholesterol*.—45.5 per cent of cases showed a definitely raised cholesterol concentration, 22.7 per cent a lowered concentration.

6. *Gall-bladder calcium*.—44.9 per cent of cases showed a definitely increased calcium concentration, as against only 7.3 per cent having a decreased concentration. The mean values throughout were definitely above the mean normal value, but the variations with the blood cholesterol were not always in the same direction. These variations are, however, in the opposite direction to those of the bile calcium.

7. The great majority of cases, whatever the value for blood cholesterol, showed marked changes in the chemical composition either of the gall-bladder or bile or both.

8. No particular type of stone was found to be associated with any special type of chemical change in the other materials examined.

DISCUSSION.

The experimental results just quoted clearly show that the presence of gall-stones is very frequently associated with considerable changes in the gall-bladder and the bile, and, moreover, that hypercholesterolaemia is a frequent accompaniment of such changes. Hitherto, apart from the deposition of cholesterol, calcium, and bile pigments in the formation of stones, this change in blood cholesterol has been the outstanding chemical change noted in connection with cholelithiasis, and there has naturally been a tendency to regard it not merely as an event, but as a causal factor, in the disease. It is a well-known fact, however, that diabetics, who, owing to diet restrictions, eat a comparatively large amount of foods rich in cholesterol, develop a hypercholesterolaemia which is frequently of a degree much higher than that found in patients with gall-stones, yet we are not aware that these diabetics have a correspondingly increased tendency to develop gall-stones. Moreover, if a constitutional tendency to hypercholesterolaemia were a cause of gall-stones, there is no reason to believe that mere removal of the site of stone formation—the gall-bladder—should remove this tendency—i.e., hypercholesterolaemia should persist after removal of the gall-bladder. In order to test this hypothesis we have made blood-cholesterol determinations in a number of cases in which the gall-bladder had been removed some months before. The results are shown in *Table III*.

Table III.—EFFECT OF CHOLECYSTECTOMY ON THE BLOOD CHOLESTEROL.

CASE NO.	DATE OF OPERATION (1925). BLOOD SPECIMEN A FEW HOURS PREVIOUSLY	BLOOD CHOLESTEROL	DATE OF SECOND BLOOD SPECIMEN (1926)	BLOOD CHOLESTEROL
		per cent		per cent
7	Feb. 17	0.272	June 4	0.121
12	March 20	0.290	June 4	0.188
13	March 20	0.215	June 7	0.190
15	March 26	0.180	June 14	0.155
18	April 3	0.140	June 7	0.150
22	April 17	0.185	June 7	0.140
24	April 24	0.250	June 7	0.155
29	May 20	0.213	June 7	0.160
43	July 31	0.135	June 3	0.145
44	July 31	0.160	June 4	0.120
56	Oct. 16	0.210	June 4	0.160

It will be seen that, where the blood cholesterol was higher than normal before operation, the removal of the gall-bladder has been followed by a marked decrease in blood cholesterol to within normal limits. Where the blood cholesterol was normal before operation the effect of cholecystectomy was negligible. This decrease in blood-cholesterol cannot be attributed to dietetic measures, for all the patients were of the hospital class who are notoriously averse to strict dietetic control over a considerable period, and all stated that they had resumed their normal diet. It is clear, therefore, that the hypercholesterolemia associated with gall-stones is closely bound up with the gall-bladder and its contents. Hence, any inquiry into the cause of gall-stone formation must be directed to the gall-bladder itself, and a satisfactory theory must account for the chemical changes in the gall-bladder wall and bile which we have noted, and for the tendency to hypercholesterolemia. If we account at the same time for an increased cholesterol content of the blood, gall-bladder, and bile, together with the formation of solid deposits of cholesterol within the gall-bladder, then we must also account for an increased total amount of cholesterol within the body. We have already suggested that increased intake of cholesterol does not of itself account for the formation of gall-stones, though it explains the production of a hypercholesterolemia. If we examine the possibility of a diminished loss of cholesterol from the body, such a condition, taken into consideration with certain functions now known to be carried on by the gall-bladder, offers a logical and coherent explanation of all the facts brought out by our experimental work.

Loss of cholesterol occurs in the faeces. In a recent paper⁵ one of us (F. S. F.) has shown that the average amount of 'unsaponifiable matter' (which consists mainly of sterols) present in the fat of the faeces amounts to nearly 2 per cent of the total dry matter of the faeces. A diminution of this loss, resulting from a diminution in the flow of gall-bladder bile into the intestine, would account for an increase in the total amount of cholesterol retained in the body. The functions of the gall-bladder which must be considered along with this retention of cholesterol are: (1) The gall-bladder is an organ in which bile is concentrated to a considerable degree; and (2) The gall-bladder absorbs cholesterol, and probably many other substances. The first of these has been clearly shown by Rous and McMaster⁶, and is now very generally recognized. The second is indicated in the work of Boyd and also of Torinomi.⁷ Boyd also describes experiments showing that the gall-bladder can absorb iron, and quotes experiments on dogs by Harer, Hargis, and Van Meter⁸ which suggest not only that the gall-bladder possesses ready powers of absorption, but that the absorbed material passes into the lymphatics.

If we assume that there is some degree of obstruction to the outflow of gall-bladder bile into the intestine, while the inflow of dilute bile from the liver is maintained, we have, in the presence of a continual process of concentration, a normal rate of addition of cholesterol (and other substances) together with a diminished loss, which must result in the production of a bile of greater concentration than normal. At the same time we have a gall-bladder which normally absorbs cholesterol now in contact with a fluid richer than usual in this substance, so that the amount of cholesterol passing through

the gall-bladder and into the circulation will also be increased. Here, then, we have an explanation of the tendency to increased concentration of cholesterol in blood, gall-bladder, and bile. Further, a continuance of the process of concentration of the bile will ultimately result in the production of a bile which is saturated with respect to cholesterol, and any further concentration beyond this point will result in the deposition of solid cholesterol from the overcharged solution, i.e., we shall get the formation of stones. The assumption we have made would appear therefore to account, in the main, for our experimental findings with respect to the changes found to accompany gall-stones, at any rate so far as cholesterol is concerned. We shall return later to a consideration of the part played by calcium.

In looking for a cause which should bring into operation the process we have outlined, our attention is at once drawn to inflammatory processes. Moynihan, Hurst, and others have so clearly shown the connection between cholecystitis and cholelithiasis that we do not intend to bring forth any arguments to prove this relationship. What concerns us is how cholecystitis may be responsible for an increased concentration of the bile by the processes we have suggested. A diminished outflow of bile from the gall-bladder can be conceived as resulting from an involvement of the cystic duct in the inflammatory processes, whereby the mucosa becomes swollen, with consequent narrowing of the lumen. Such a condition of the duct would undoubtedly result in considerably less obstruction to the inflow of the dilute liver bile than to the outflow of the more viscid gall-bladder bile, especially as the viscosity of the latter is further added to by an increased supply of mucus as a result of the inflammatory process.

In addition to inflammatory processes it appears necessary to take into account the possibility that alteration of the mechanical conditions within the abdomen may, by interfering with the normal outflow of bile into the intestine, also result in the processes we have outlined in a certain proportion of cases. Thus the profound mechanical disturbance resulting from the presence of the continually enlarging uterus of pregnancy may, along these lines, explain the hypercholesterolemia which has been shown to be associated with that condition, and the relatively large incidence of gall-stones in women who have borne children.

Having outlined the processes involved in gall-stone formation, together with their probable cause, we propose to discuss certain matters in greater detail.

Boyd's evidence shows that the formation of deposits of cholesterol ester in the mucosa of the gall-bladder is an important feature in many cases of early cholecystitis, while it appears in the fibrosa at a much later stage. Our own experimental results show that considerable increase of cholesterol in bile and gall-bladder may be present, along with a normal blood-cholesterol (*see Fig. 403*), thus suggesting that the first stage is a deposition of cholesterol in the gall-bladder mucosa, along with, and probably on account of, increased bile concentration, and that subsequently the increased cholesterol of the gall-bladder results in the passage of increased amounts of cholesterol into the blood-stream, i.e., increased bile concentration precedes increased cholesterol absorption—a finding in agreement with our theory. Further, the

great variation possible in the degree of restriction of the outflow of bile from the gall-bladder accounts for the well-known variation in the rate at which gall-stones may be formed. While the rate at which solids are deposited from the bile will depend on the rate and degree of its concentration, their formation will also depend on the presence of suitable nuclei for crystallization. In the absence of a suitable nucleus lying free in the gall-bladder, supersaturation of the bile to a very considerable degree may occur before crystallization results, and, during this period of supersaturation, deposition of cholesterol in the gall-bladder mucosa will be taking place. Then, to quote Boyd again, "as this deposit of lipoid increases in bulk, the villus in which it is contained may develop more and more into a papillomatous-like process, the stalk of which finally becomes so attenuated that separation is inevitable. When that occurs we have a foreign body composed of cholesterol and albuminous material lying in the cavity of the gall-bladder and forming an ideal nucleus for the formation of further deposits". Such conditions account for the strawberry gall-bladder as a state preceding stone formation. Once there is a suitable nucleus, crystallization around it will take place rapidly or slowly according to the degree of supersaturation of the enveloping bile. Moreover, if crystallization of a substance takes place rapidly from a solution supersaturated by that substance, the crystals will be fairly pure and contain little of other materials present in the solution—hence the 'pure cholesterol stone'. If, however, a suitable nucleus is originally present, we may not get a high degree of supersaturation with subsequent rapid crystallization, but crystallization around the nucleus will begin to occur immediately the concentration of the bile exceeds the saturation value, and will proceed comparatively slowly. Under such conditions the stone will contain, besides the substance in which the solution is supersaturated, considerable amounts of other materials present in the solution. In this connection it is interesting to note that in the four cases in which we have demonstrated the presence of foreign material in the stones, namely three (*Cases 4, 12, and 23*) with copper, and one (*Case 5*) with cotton fibres, the stones contained an appreciable quantity (1.0 to 6.4 per cent) of calcium, compared with 0.1 per cent or less in the 'pure cholesterol' stones.

So far we have only considered the part played by cholesterol. When we turn our attention to calcium, we find similar results with regard to the blood and gall-bladder, but a difference in the bile. Corresponding to the tendency to hypercholesterolemia, our experimental results have shown a tendency to hypercalcaemia. It is not necessary that the tendency to each should be of the same degree, since there is no reason to assume that the absorptive power of the gall-bladder should be the same for different substances. Further, the concentration of calcium in the bile is of a different order from that of cholesterol, the normal value for the latter being about 200 mgrm. per 100 c.c., while that of the former is only about 20 mgrm. per 100 c.c. The gall-bladder shows the same change with respect to calcium as it does to cholesterol, namely, an increased concentration; but, whereas the cholesterol content of the bile is frequently increased, its calcium content is very rarely exceeded, but on the contrary tends to be reduced. These findings are confirmed by Lichtwitz and Bock,⁹ who failed to find any increase in calcium in the bile from an inflamed gall-bladder. This fact at first sight would appear to

contradict our view that concentration of the bile is the cause of stone formation, unless at the same time we take into consideration the changes in the gall-bladder calcium. The average figure throughout our series for the calcium in the gall-bladder is approximately 160 mgrm. per 100 gm. compared with a normal value of 110 mgrm., i.e., there is on the average an increase of 50 mgrm. per 100 gm.; whereas the average figure for calcium in the bile is about 17 mgrm. per 100 c.c. compared with a normal of 23 mgrm., i.e., a decrease of only 6 mgrm. per 100 c.c. There is on the whole, then, a concentration of calcium, but, as a result of this concentration, deposition of calcium occurs in the gall-bladder without the appearance of increased calcium in the bile. The form of the curves in *Fig. 403* for calcium in gall-bladder and bile offers strong support to the view that low calcium content of bile is not due to lack of concentration but to deposition in the gall-bladder.

We are not able to offer a precise explanation for this failure to attain a high calcium content in the bile, but certain possibilities suggest themselves. The blood calcium is 9 to 11 mgrm. per 100 c.c., and blood is normally near its saturation point with respect to calcium. The bile calcium is approximately double this quantity, and is believed to be kept in solution by the cholesterol and the bile salts present in the bile. It may be that the solution of calcium in normal bile is already in an unstable condition, with a constant tendency to deposition, but with the normal flow of fluid through the gall-bladder actual deposition there does not occur. Any stasis occurring with respect to gall-bladder bile will favour the deposition of calcium, and hence the production of a reduced bile-calcium concentration. If this view is correct, then the theory we have suggested to account for gall-stone production and its attendant phenomena receives support and not contradiction from the observed tendency to decreased calcium concentration of the bile, since the theory necessarily implies some degree of stasis of gall-bladder bile. Experimental confirmation of this view is suggested by the work of Drury.¹⁰ He found that gall-stones frequently formed in dogs intubated for the collection of bile under sterile conditions. The stones consisted almost entirely of calcium carbonate and calcium bilirubinate. He also made a day-to-day study of the sediment of the sterile liver bile of intubated dogs, and found a marked tendency to deposition of calcium carbonate therefrom. A further point in favour of the view that there is a constant tendency for the bile to deposit calcium (which tendency will be increased by the presence of an appropriate nucleus) is seen in the fact that all gall-stones not of recent origin are found to be surrounded by a shell rich in calcium salts, chiefly the carbonate.

With regard to the question as to why calcium carbonate predominates in some cases and calcium bilirubinate in others, we are again unable to offer any evidence of our own. Wells quotes evidence suggesting that the presence of the positively charged protein substances from inflammatory exudates leads to the precipitation of calcium bilirubinate (which is electro-negative) from bile, and hence the formation of pigment calculi is favoured or initiated by inflammation of the biliary tracts. On this view the amount of calcium bilirubinate found will have some relation to the degree and extent of the inflammatory processes occurring, and will vary in different cases—a result amply confirmed by experience.

If the deposition of calcium (in either form) occurs before crystallization of cholesterol, a nucleus around which the cholesterol can be deposited will be present. We shall thus get a type of stone which is, in fact, very frequently found, namely, the cholesterol stone with a calcium-containing nucleus.

We have so far shown how, starting with a partial obstruction to the outflow of bile into the intestine, due no doubt in most cases to an inflammatory process in the gall-bladder, there results an increased concentration of the bile contained therein, with an accompanying tendency to hypercholesterolæmia and hypercalcæmia, and how, under the conditions so produced, the different varieties of gall-stones may be formed. If a patient suffering from cholecystitis comes for examination during the active stage of the disease, we ought to find hypercholesterolæmia and possibly hypercalcæmia; but in view of the fact that a disturbance of the blood calcium seems more difficult to produce than a disturbance of the blood cholesterol, the former will not be so frequently found as the latter. In addition, we should find a bile with high cholesterol concentration and normal or reduced calcium concentration and a gall-bladder containing an increased amount of both substances.

We may or we may not find stones. *Cases* 55 and 62, for example, represent such a state of affairs without stones, and *Cases* 12 and 41 give similar findings with stones also present. The proportion of cases which come for examination and treatment during an early attack is, however, small. In many cases the inflammation subsides, with a consequent tendency for all concentrations to return to normal. It does not follow, however, that all return to normal at the same rate or reach normal values in the same time. The type of result obtained subsequent to an attack may therefore present many variations between the typical cases quoted and the strictly normal. Infection, however, is often periodic. Subsequent attacks may occur with a repetition of the former processes, which, however, may be modified by changes in structure, composition, and function of the gall-bladder, produced either by a former inflammatory process or as a result of the presence of stones formed in an earlier attack. The findings in such cases, too, will be altered in one or more particulars from those of the typical cases quoted. Our own series is obviously a mixture of early and late cases, and this accounts for the great variation in the results obtained.

A few words remain to be said concerning 'white bile'. Our experimental findings regarding this fluid agree with those of other workers, namely, that it has lost, or is in the process of losing, practically all its cholesterol and calcium. That this is not due simply to deposition of these substances in the gall-bladder is shown by the fact that in these cases the gall-bladder cholesterol and calcium are not uniformly increased. The results support the view that both calcium and cholesterol are absorbed by the gall-bladder and passed on to the blood-stream. Our results show that 'white bile' may coexist with either raised or normal blood cholesterol and calcium. This does not appear to us to be contrary to the view we have already expressed that high blood cholesterol and calcium are primarily due to concentration of the bile. Occlusion of the cystic duct and consequent cutting off from the gall-bladder of further supplies of liver bile will undoubtedly mean the

beginning of the end so far as high blood cholesterol and calcium are concerned; but it is quite conceivable that the production of 'white bile' may be a more rapid process than the return of a high blood cholesterol or calcium to a normal level. Consequently the finding of raised or normal blood values will depend on the time which has elapsed between the occlusion of the cystic duct and the examination of the blood.

The views we have expressed represent to us a logical explanation, consistent with known chemical facts, of the many phenomena associated with cholelithiasis, and, moreover, do not appear to overstrain the probabilities as demonstrated by our own work or that of the majority of other workers in this field. In particular they appear to offer a more satisfactory explanation of the relation of this condition to hypercholesterolaemia. They suggest that hypercholesterolaemia is typically present in the acute stages of disease responsible for gall-stone formation, and that it disappears with the passing of this acute attack. Its diagnostic value is not that it indicates the presence of gall-stones or cholecystitis, but that it indicates a present or recent attack of the disease, and its indication is further strengthened if accompanied by high blood calcium. Our views consequently show how gall-stones may be found without an accompanying hypercholesterolaemia, and suggest that apparently varying and contradictory findings of different workers with respect to hypercholesterolaemia in cholelithiasis may simply be due to the fact that examinations have been made in different stages of the disease.

We are well aware that the idea of bile stasis as a factor in gall-stone formation has often been suggested. While our work was not undertaken with the object of supporting this or any other view, but simply to try to obtain further information respecting cholelithiasis, our results have forced us to the view we have outlined, and, we believe, have shown how the stasis we have suggested is linked up with the other changes which are found in this interesting condition.

In conclusion we wish to express our very deep indebtedness to Sir Berkeley Moynihan, at whose suggestion this work was undertaken. He has throughout shown the greatest interest in its progress, and moreover has supplied us with all our material. We are also indebted to Dr. Elaine Knowles, who has collected the clinical notes of our cases, and to our colleagues on the staff of the bacteriological department of the University for carrying out the bacteriological examinations of gall-bladder and bile.

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INTRATHORACIC NEW GROWTHS: AN ACCOUNT OF SEVEN OPERABLE CASES.

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THORACIC surgery has made very great strides in the last twenty years, and not only have certain difficulties as regards the effects of freely opening the pleura been overcome, but definite advances have been made in our methods of diagnosis. Intrathoracic growths have been regarded in the past as comparatively rare, but either they have increased considerably in number during the last ten years, or else methods, especially X-ray, have made a definite diagnosis in cases which previously were overlooked or misdiagnosed.

At present malignant disease arising in the chest—mediastinum, pleura, or lung—unfortunately rarely offers any hope of radical operation. This results from two factors: the first, that as a rule it commences insidiously, and until extension to surrounding structures, such as pleura or bronchi, occurs there are no localizing symptoms, the general symptoms of lassitude and loss of weight alone being present. Therefore at the time when diagnosis is possible the growth is too extensive for any radical operation. The second factor is the site of origin of malignant disease. In the vast majority of cases the start is in the mediastinum in close relationship with vital organs or the structures in the hilum of the lung, where it would entail, at least, complete unilateral pneumectomy before there could be any hope of eradicating the disease.

There are, however, two types of malignant disease which offer reasonable hope of radical treatment: (1) Localized endothelioma of the pleura; and (2) The so-called alveolar carcinoma—as the latter arises in the neighbourhood of the middle of the lobe. *Case 5* in the following reports was taken at operation to be of the latter type, but proved histologically to be an endothelioma arising, it would appear, in the lower lobe. In an experience of about forty cases of malignant disease of the lungs and mediastinum this was the only one which offered any hope of complete operative removal, although many others were explored and abandoned after removal of a portion for histological examination.

METHODS OF DIAGNOSIS.

Apart from the usual clinical examination which is always made, there are certain very valuable further examinations which should never be neglected.

X Rays.—This method has proved invaluable. Greater precision is being rapidly attained as experience becomes wider, for the study of radiograms and the screen examination of the chest offer great initial difficulty in their interpretation. In addition to the accepted anteroposterior and postero-anterior examinations, true lateral and oblique skiagrams offer considerable

assistance in diagnosis. Further X-ray examinations should be made after the induction of artificial pneumothorax or the intratracheal instillation of lipiodol.

Artificial Pneumothorax.—The introduction of oxygen or other gases into the pleural cavity, where pleural adhesions do not prevent the establishment of pneumothorax, is often of much help in the elucidation of the relationship of tumours to the lung (see *Case 1*). The amount required generally is about 1500 c.c. of gas introduced on two or three separate occasions, followed by radiography.

Thoracoscopy.—The visual demonstration of the tumour by means of the thoracoscope can often be of value, giving a further indication of the relationship of lung and tumour or of the attachments and surface appearance of the tumour. This was done on three occasions (*Cases 1, 3, 7*), but was impossible in the others owing to inability to establish a pneumothorax.

Lipiodol Injection.—The intratracheal instillation of lipiodol will map out the bronchial tree in a subsequent skiagram, which should include lateral as well as anteroposterior views. Its value has not been so marked in this series, but should prove of use in some cases, especially where partial obstruction of the bronchus occurs as a result of the presence of small intrabronchial tumours.

Bronchoscopy.—In a certain proportion of cases bronchoscopic examination is essential, and especially in those where evidence of bronchial obstruction, with signs of early bronchiectasis, is present.

Œsophageal Examination.—Where preliminary X-ray examination shows a shadow of presumptive tumour in the mediastinal area, the administration of barium with subsequent radiological examination of its passage through the œsophagus will often disclose important relationships. Further, œsophagoscopy will in certain cases show displacement or bulging, or even actual ulceration into the lumen of the œsophagus.

In this paper it is not proposed to discuss the differential diagnosis of the various types of tumours or review the previous literature; it is published with a view to demonstrating the possibility of successful removal of at any rate the benign tumours arising within the thoracic cavity, and to show that, in much rarer cases, malignant growths of certain types, and arising in certain positions, can be completely and successfully eradicated.

In the majority of cases it is difficult to decide before operation whether the growths are benign or malignant, and even in the early stages of exploration their nature may be in doubt (see *Case 4*). This raises a point which requires considerable emphasis—namely, that intrathoracic tumours, after full examination by all known methods, should always be submitted to an exploratory thoracotomy, and that, even when exposed, and appearances suggestive of malignancy—hard nodulations—are present, they should always be explored by: (1) Aspiration through a large-bore needle; and (2) Actual incision into the growth and the removal of a portion for microscopical examination.

Benign growths eventually destroy life by increase of size and pressure on vital organs; but before this the patient is often a chronic invalid for several years, and the earlier these tumours are removed the easier the

operation and the greater the certainty of complete recovery. Lastly, a fairly large proportion of the growths are either of a mild malignant nature—fibro-chondro-sarcomata, which do not commonly recur if removed completely and widely at an early stage, or teratomata, which are essentially liable to undergo malignant changes; there are three cases of these in this series. These results—the liability to destroy by direct pressure on vital structures and to undergo malignant change—are strong indications for operation as soon as possible after diagnosis of the presence of tumour.

CASE REPORTS.

Case 1.—Chondrosarcoma of the 2nd, 3rd, and 4th ribs. Intrathoracic removal: recovery.

E. M., female, age 57, admitted to the Brompton Hospital under Dr. Nelson on Dec. 3, 1923.

HISTORY.—The patient had always enjoyed good health until four to five months previously, when she had a severe cold. Two months before admission she developed a bad cough, with pain in the upper right chest. There was slight loss of weight and a very slight amount of sputum, which was negative for tubercle bacilli on two examinations.

ON EXAMINATION.—There was dullness over the upper part of the right chest, with diminished breath-sounds and expiration prolonged; vocal resonance and fremitus were absent. The signs were present anteriorly and posteriorly.



FIG. 404.—Case 1. Skiagram of chondrosarcoma in upper right thoracic cavity. Small black ring has been placed there for stereoscopic purposes.



FIG. 405.—Case 1. Artificial pneumothorax has been induced. Note edge of collapsed lung internal to and away from tumour.

X-ray Examination.—This showed a large globular opacity, occupying the upper portion of the right chest, with well-defined edges (Fig. 404). Artificial pneumothorax was successfully performed with oxygen, and subsequent skiagrams were taken. These showed the tumour standing out well from the collapsed lung, and therefore extrapulmonary (Fig. 405).

Thoracoscopy (Dec. 12).—The tumour was seen from four different points of view, as shown in *Fig. 406*, its attachment being anterior.

OPERATION (Dec. 18).—Endotracheal anaesthesia (Dr. Magill). An incision was made below the right breast, which was turned forwards as a large flap, and the



FIG. 406.—*Case 1.* Thoracoscopic views of tumour. They show: the upper part of the tumour with apex of right pleural cavity above (upper view); the inner edge of the tumour lying upon normal lung (left view); the outer edge of the tumour with parietes in the distance (right view); and the lower border of the tumour with lung subjacent (lower view). Taken together they give the whole outline of the tumour from the postero-external aspect of the chest.

pectoralis major was split in the line of its fibres. The chest was entered in the 4th intercostal space through a 5-in. incision, which exposed the lower edge of the tumour. Towards the middle line the 4th costal cartilage was divided and the tumour more easily defined. It was found to be arising from the 2nd and 3rd ribs, which were incorporated with it on their deep surfaces. The deep incision was carried up through the 3rd and 2nd costal cartilages and interspaces, and the upper limit of the tumour was seen to extend up to the 1st rib. The nervous and vascular structures to the right upper limb were displaced upward by elevation of the arm and by suitable retractors, and the muscles of the first intercostal space were incised.

The outer boundary of the tumour was now defined and the intercostal muscles and ribs were divided, the latter after crushing with bone forceps, and the tumour, with portions of the 2nd, 3rd, and 4th ribs and intercostal spaces, was removed. The pleura was carefully dried, and the pectoralis major, which had been retracted during the operation, was sutured, the lung being inflated before tying the final suture. The breast, which had been displaced inwards, was now turned out-



FIG. 407.—Case 1. Drawing of tumour immediately after removal. This is from the pulmonary aspect, and at the upper end can be seen the divided 4th rib. ($\times \frac{1}{2}$.)



FIG. 408.—Case 1. Skiagram of chest, two months after operation. Close examination shows absence of the anterior ends of the 2nd, 3rd, and 4th ribs, and parts of their costal cartilages.

wards to its normal position as an extra covering, and sutured.

There was some degree of shock after the operation, but the pulse on the same evening was 108 and regular. On the fourth day 5 oz. of blood-stained effusion were removed from the chest. Following this, convalescence was uninterrupted.

PATHOLOGICAL REPORT.—(This is taken from the specimen in the R.C.S. Museum.) (Fig. 407.) Ovoidal chondrosarcoma measuring 4 by $2\frac{1}{2}$ in., together with portions of 2nd, 3rd, and 4th ribs. It is smooth on the surface, surrounded by a fibrous capsule in which are numerous ramifying blood-vessels, and in section is seen to be devoid of lobulation and to consist of a tissue of obscurely fibrous appearance in which are scattered rounded vessels of considerable size appear in the section. At the upper end of the specimen

is an outlying process of the growth which is apparently an infiltration of the rib or of the fatty tissue about an intercostal space.

Microscopical examination shows the growth to be a chondrosarcoma. It consists of spindle cells among which are several groups of large multinucleated cells. The tumour tissue also contains numerous small trabeculae of imperfectly developed cartilage.

A skiagram taken three months later shows an apparently normal chest, but close examination shows absence of the anterior end of the 2nd, 3rd, and 4th ribs (*Fig. 408*).

In this case the interest lies in the fact that the whole of the growth arose from the deep surface of the rib or ribs and that there was no external evidence of tumour. The diagnosis as regards the exact position, the relationship between lung and tumour, and the appearance of the tumour was made before operation.

The author believes this to be the first case of intrathoracic tumour in this country in which artificial pneumothorax and thoracoscopy were used to aid diagnosis before operation, and in which therefore it was possible to plan the incision through superficial and deep parts of the thoracic wall so as to give best access for removal of the growth.

Case 2.—Cyst in left lower pleural cavity. Removal: recovery.

Miss S. G., age 30, nurse, a patient of Dr. G. Basil Price.

HISTORY.—The patient joined the Army in 1916 and served in Salonika for four months, being invalided home for dysentery and malaria in December, 1916. She

was in England for four years, and then served in Germany until demobilization in 1922. In 1918 there was a sudden attack of influenza, sore throat, and pain in the left side. Fluid was stated to be present, but was not aspirated. She returned to duty in two months, but never felt well subsequently, having cough and pain in the left side at intervals. She has been in sanatoria on and off for the last three years.

Fluid was aspirated in January and September, 1923, and in October, 1924—12 to 24 oz. each time. Straw-coloured fluid was withdrawn at first, but later it became brownish. There was no wasting, but considerable loss of strength and energy, and definite dyspnoea. Sputum had been examined on several occasions, but was always negative for tubercle bacilli.

ON EXAMINATION.—Diminished expansion of the left lower chest, with dullness and absence of breath-sounds up almost to the spine of the scapula. No tactile fremitus was elicited over the same area. The heart was not displaced. There was no evidence of disease of the right lung, and no adventitious sound in the left lung. Abdomen, no



FIG. 409.—*Case 2.* Skiagram of large cyst in left pleural cavity. Note apex of tumour lies over cardiac area and not towards hilum of lung.

appreciable disease. Temperature, normal; sputum, nil. Fluid was aspirated from the left chest and found to consist of a serous fluid loaded with cholesterol crystals, which gave it a brown colour and shimmering appearance. No organisms were present.

X-ray Examination.—This shows a large pear-shaped shadow with the apex towards the middle of the heart shadow (*Fig. 409*).

Artificial pneumothorax was impossible owing to adhesions. A diagnosis of intrathoracic cyst was made.

OPERATION (May 8, 1925).—Intratracheal anaesthesia (Dr. Magill). A curved incision was made from the axilla downwards on the outer side of the left breast. The breast was turned forward and the 5th interspace opened up. Adhesions to the pleura were separated, and showed a large tumour present in the lower part of the left pleural cavity. It was adherent to the lung above and posteriorly, the diaphragm below, and the

FIG. 410.—Case 2. Skiagram after removal of cyst shows a certain persistence of the cavity from which the cyst was removed and formed by compressed pulmonary tissue. This was taken three weeks after operation.



pericardium internally. The adhesions were separated at all points except the pericardial attachment, which was very dense over an area the size of a five-shilling piece. It was considered more advisable to leave this than remove the involved area of pericardium, and the cyst was then removed after incision.

The lining membrane of the portion left behind was then excised, leaving only a thin layer of the fibrous outer coat behind.



FIG. 411.—Case 2. Large cyst removed from left chest. Opening at apex shows where a small portion has been left behind on the pericardium, the lining being removed, and where sections have been cut for microscopy. ($\times \frac{1}{3}$)

No communication with the pericardium was present. The chest was swabbed dry, and the chest wall sutured by five pericostal sutures and the muscles in layers. Before tying the last suture the lung was distended by positive intratracheal pressure as far as possible. The condition of the patient was excellent on leaving the table. The cyst on removal held between $1\frac{1}{2}$ and 2 pints of fluid.

Four days later 22 oz. of clear fluid were removed from the chest; on examination this proved sterile. Ten days later another 6 oz. were removed. Convalescence was steady and uninterrupted. A skiagram taken three weeks after operation showed a diminished cavity from which the cyst had been removed (Fig. 410). A

skiagram taken after four months showed full expansion of the lung, with disappearance

of the old pleural thickening, and the physical signs were normal. (Unfortunately the skiagram was lost, and the patient being in a remote part of Ireland has prevented another being taken.) She is now quite fit and without symptoms.

PATHOLOGICAL REPORT.—(This description is from the specimen in the R.C.S. Museum.) (*Fig. 411.*) A large cyst removed by operation from within the chest. It measures nearly 5 in. in diameter, and is covered partly by pleura, partly by loose areolar tissue. Its wall is in part several millimetres in thickness, in parts as thin as tissue paper. It has a smooth lining and contained a brownish fluid with crystals of cholesterolin.

Microscopic examination shows the cyst wall to be composed of dense hyaline fibrous tissue. No epithelial or endothelial lining can be detected.

The first interesting feature about this case is the diagnosis. For three years it had been taken to be an encysted collection of fluid, probably tuberculous in nature. The points against this diagnosis are the localized nature of the disease, the X-ray appearance, and the lack of generalized symptoms. Taking them seriatim, it is improbable that an encysted collection of tuberculous nature would be so long-standing as seven years without there being evidence of other changes in the lung itself. The X-ray appearance shows one feature which in the author's opinion militates against the diagnosis of an interlobar effusion—namely, that the apex of the pear-shaped shadow is directed to a point well below the position of the hilum of the lung, where one would expect it in an interlobar effusion. There would probably be more marked loss of weight, sweating, and other symptoms in tuberculous effusion in which the disease was active, and, lastly, one would expect the fluid withdrawn from the cyst to be thicker and more cellular in nature.

The other question of interest is the origin of the cyst. The absence of a true cellular lining makes exact diagnosis impossible. Is this a dermoid cyst arising in the anterior mediastinum and enlarging, which takes the line of least resistance into the pleural space, compressing the soft lung; or is it a primary diverticulum from the pericardium, the communication of which has become shut off as enlargement occurred? A definite answer is impossible, but its firm attachment to the pericardium is rather in favour of the latter. The loss of the lining membrane may have occurred owing to repeated hæmorrhages into the cyst, which also accounts for the excessive quantity of cholesterolin present.

Case 3.—*Teratoma of right lung—rupture into lung. Removal in two stages: recovery.*

Miss D. P., age 20, admitted to the private ward at Brompton Hospital under Dr. G. E. Beaumont on Oct. 5, 1925.

HISTORY.—Pain in the right shoulder, with dullness of the right chest. Exploration with a needle gave a negative result; diagnosed as tuberculosis or growth. Shortly after she coughed up a 'lot of matter'.

In 1922 there were bulging of the right side in the neighbourhood of the nipple; cough, and offensive sputum; dullness still present. The sputum gave a ? + reaction for tubercle bacilli. The chest was explored three times, but no fluid was found.

In 1925 the patient was fairly well until the early months; she then had influenza (?); she was X-rayed, and fluid was reported in the chest, which was aspirated weekly (60 oz.). The fluid was originally cheesy and thick, but later more fluid and chocolate in colour.

ON ADMISSION.—The patient was gravely ill, with high temperature and pulse, and expectorating 25 oz. of foul-smelling sputum.

ON EXAMINATION.—There were signs of dullness over almost the whole of the

right chest, 32 oz. of 'anchovy fluid' were withdrawn, and 175 c.c. of air introduced. Microscopical examination of the fluid showed small masses of sebaceous material with two hairs. The sputum contained no tubercle bacilli, and there was no evidence of dermoid contents.

X-ray Examination.—Showed a cavity in the chest with fluid in the lower portion and a rounded tumour at the upper end (Fig. 412).

Thoracoscopy (Oct. 29).—This showed a large space with fluid below and masses of sebaceous material floating on the surface. Above, a tumour could be seen passing from the inner to the outer part of the apex of the cavity, the former attachment being broad and the latter narrow.

FIRST OPERATION (Nov. 2).—Thoracotomy under intratracheal anaesthesia (Dr. Magill). Intercostal incision in the 5th interspace in the anterolateral part of the chest after turning up the right breast. The pleural cavity was opened, and one pint of fluid was found, of thick soup-like consistency and containing hairs and masses of material like yolk of egg. The cavity was swabbed dry and found to be completely surrounded by lung, the peripheral part being thin, solid, and airless. In the upper part of the cavity was a tumour the size of a tangerine orange attached to the

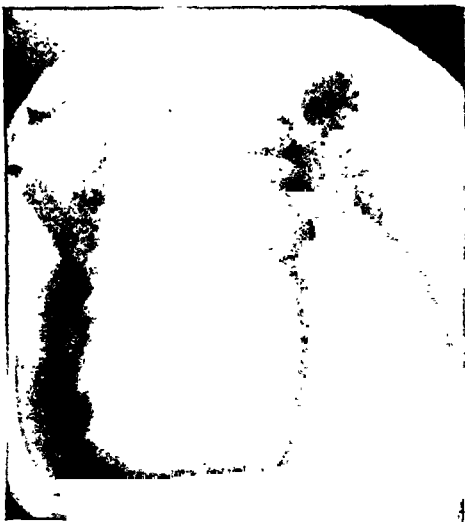


FIG. 412.—Case 3. Skiagram of right chest, showing large cavity in lung in which most of the fluid has been withdrawn and replaced by air. In upper portion is seen an irregular tumour.



FIG. 413.—Case 3. Skiagram showing appearance of chest after removal of tumour.

upper lobe bronchus. This was removed as far as possible, without damage to the bronchus, and consisted of multiple cystic areas. The upper part of the pulmonary cavity was lined by what appeared to be normal skin, probably as a result of previous rupture of a cyst. This lining was removed intact. The main portion of the pulmonary cavity, which did not communicate with the bronchial system, had calcified plaques in the walls, large portions being removed at operation. At the end of the operation the chest wall was closed without drainage.

After-treatment.—Fluid was removed at intervals of a few days on six occasions, starting with 2 pints and going down to 11 oz. No further fluid could be obtained, and the lung was expanding well—confirmed by radiography. The sputum immediately disappeared, and was obviously due to secondary dilatation of the lower bronchi by pressure. The wound remained healed for six weeks, and the patient was up and about when a small area broke down and was found to lead to a track in the lung. The patient was temporarily discharged with a tube *in situ*.

SECOND OPERATION.—Owing to inability to replace the tube, the patient was readmitted. The old thoracotomy wound was reopened, and the remainder of the tumour, which had become further extruded from the lung, was removed without very much difficulty. The chest was closed around the tube after removal of a few calcified plaques.

Convalescence was uninterrupted, and on Sept. 10, 1926, the patient was discharged with the wound soundly healed and full lung expansion. Her general health was excellent. (*Fig. 413.*)

PATHOLOGICAL REPORT.—Microscopic section shows large masses of sebaceous glands, with connective tissue interspersed, and covered at certain points by stratified squamous epithelium.

This patient shows the result that may be expected to occur when intrapulmonary teratomata are left alone, and affords a very good reason why removal should be attempted as soon as a diagnosis is made.

There is no doubt that one of the cavities of the multiloculated tumour burst into the lung, forming an extraneous cavity surrounded by lung tissue. The constant secretion from the wall of the cyst gradually increased the size of the pulmonary cavity until it held a large quantity of fluid and caused complete collapse of the surrounding lung. The pressure of the fluid gave rise to definite obstruction to the bronchi of the lower lobe, resulting in a condition of bronchiectasis, which increased until the sputum amounted to 25 oz. per diem. The relief of the pressure was shown by the almost immediate disappearance of sputum following operation.

The operative difficulties are increased also by the delay in adequate treatment, as the tumour loses its definite boundaries and the line of cleavage is not so clearly defined.

Case 4.—Teratoma of lung, removed in three stages: recovery.

J. G., age 27, male clerk, admitted to the Brompton Hospital under the care of Dr. Hope Gosse on Nov. 16, 1925.

HISTORY.—The patient had a fall in March, 1925, followed by pain in the right chest and back for one month. In June there was recrudescence of pain. In September cough came on gradually, later with expectoration, and three weeks before admission there was a definite attack of hæmoptysis.

ON EXAMINATION.—The physical signs consisted of absence of breath-sounds over an area of the front of the right chest from the upper border of the 2nd rib and costal cartilage to below the 6th rib. In this area there was complete absence of breath-sounds and vocal fremitus. The temperature was 98.8–99°, pulse 80–96. A needle was inserted into the dull area without result.

X-ray Examination.—A skiagram showed a large tumour present in the right lung (*Fig. 414.*)

Artificial Pneumothorax.—This was induced with a view to clearing up the diagnosis, but was only partial in its result owing to adhesions.

Lipiodol Injection.—The skiagram following injection indicated that the bronchi were free and not dilated.

FIRST OPERATION (Jan. 6, 1926).—The chest was freely opened by an intercostal incision in the 5th space anterolaterally. Normal lung was visible above and the diaphragm below. The middle portion of the lung contained a large mass, about the size of a grape-fruit, firm in consistency, with very hard nodules over its surface, and covered by about half an inch of collapsed lung. It was first thought to be malignant. An exploring needle was introduced into the mass with negative result.

The overlying lung was incised and a further incision made into the tumour. A quantity of hair and sebaceous material was extruded. An attempt was then made to separate the outer wall of the tumour from the lung tissue. This was difficult owing to close adhesions, and a fair amount of oozing resulted. As a result of a fall

in blood-pressure the chest was closed after separating one half of the tumour from the lung, and the separated areas were kept apart by a piece of gauze, and a water-seal drain was inserted.

Following the operation a fair amount of blood-stained serum oozed into the dressings for several days, but, in spite of a certain degree of bronchitis, recovery resulted.

SECOND OPERATION (Feb. 3).—A further exploration was done through the original incision. The tumour was held by forceps and freed completely except at its base, which extended into the mediastinum. The wound was treated in the same way as formerly. The further convalescence was interrupted by a lesser degree of bronchitis.

THIRD OPERATION (March 3).—Exploration was carried out through the previous incision, but extended upwards by division of the costal cartilages of the 5th, 4th, and 3rd ribs. The tumour now presented much more easily, and was removed without difficulty. A small bronchial fistula was present. Convalescence was much easier, and the wound and fistula healed within three weeks.

The patient, whose weight was 9 st. 10 lb. on admission (Nov. 16, 1925), weighed over 12 st. in September, 1926, and was very fit; there were no abnormal physical signs in the right chest (Fig. 415).



FIG. 414.—Case 4. Showing a large tumour in the lower right chest.

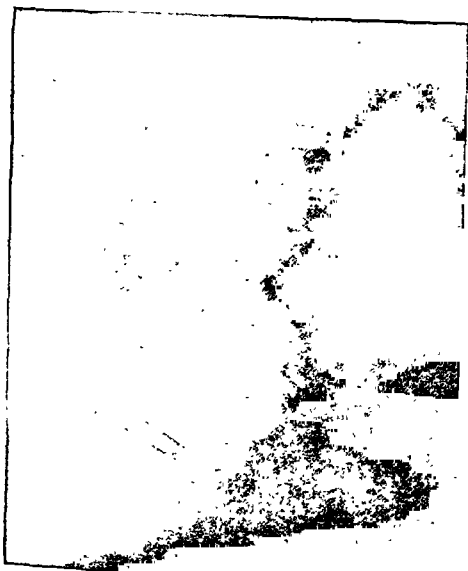


FIG. 415.—Case 4. Skiagram three weeks after removal of tumour.

This case illustrates well the necessity of proceeding in stages with the more difficult intrathoracic tumours. There is no question that the patient would have succumbed had the attempt been made to carry out the complete operation at one sitting. In addition to this, there can be no doubt that the decompressive effect of the first operation resulted in the tumour being gradually extruded, in a somewhat similar manner to the intraspinal tumours operated upon in two stages.

A point with regard to the anaesthesia can also be stated here—that when the lung is adherent there is no necessity to use any form of intratracheal anaesthesia, and that gas and oxygen given in the usual way is more satisfactory. The former was

used for the first and the latter for the two subsequent stages. Bronchitis was a more marked feature of the first post-operative period than the others.

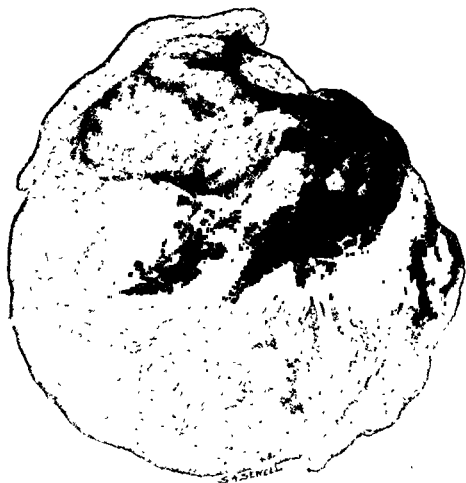


FIG. 416.—Case 4. Teratoma removed from right lung and mediastinum. ($\times 3$.)

with scattered cystic spaces, some of which contain coagulated mucus. There are also opaque white areas of cartilage, and in the upper half a slit-like space lined with skin; this cavity contained hairs. Near the left edge of the specimen are two areas containing bone.

Microscopical Examination of sections from seven different parts of the tumour shows the following tissue: True skin, with sebaceous glands (from the upper margin of the horizontal cleft); tubular spaces lined with columnar ciliated epithelium; indefinite masses of smooth muscle-fibres; lymph follicles and great numbers of mucous glands, many of them in the vicinity of the tubes lined with columnar epithelium, and in places definitely connected with them; masses of hyaline cartilage; numerous areas having the structure of neuroglia; and masses of fatty tissue. The cyst at the right edge of the specimen is lined with a non-ciliated

Small and moderate-sized bronchial fistulae heal over with lung tissue most readily if they are deeply situated and the surrounding walls of the track are not rigid.

The appearance of the first skiagram (Fig. 414) would almost suggest a malignant tumour invading lung tissue and arising in the hilar region, and only exploration proved its benign nature.

PATHOLOGICAL REPORT.—(Taken from the specimen in the R.C.S. Museum.) (Fig. 416.) One-half of a teratoma removed from the chest by operation. It is of rounded form, irregularly and coarsely lobulated on the surface, and measures 3 in. in diameter. The section shows it to be of complex structure, consisting partly of areas of fat, partly of indefinitely arranged tracts and areas of fibrous tissue



FIG. 417.—Case 4. One section from teratoma of lung and mediastinum, showing varied types of tissue. ($\times 90$.)

The cyst at the right edge of the specimen is lined with a non-ciliated

columnar epithelium, several layers thick. In one of the sections is a narrow tract composed apparently of medullated nerve-fibres. There are no evidences of any malignant changes (*Fig. 417*).

Case 5.—Endothelioma of right lower lobe. Lobectomy: death from reactionary hæmorrhage.

H. F., male, age 60, admitted to Westminster Hospital under Sir James Purves-Stewart on Jan. 8, 1926.

HISTORY.—Three years ago the patient had severe hæmoptysis—3 pints (?). One year ago he became suddenly blind in the right eye. Five weeks ago there was incontinence of urine when he walked about. He complained of continual gripping pain in the right lower back of three days' duration—worse on walking. He has had some lumbago for eighteen years. In addition to the pain there was complaint of cough, loss of appetite and sleep, wasting, and sweating.

ON EXAMINATION.—Cardiovascular system: mitral systolic murmur at cardiac apex; blood-pressure $\frac{110}{120}$; some arteriosclerosis. Respiratory system: patch of

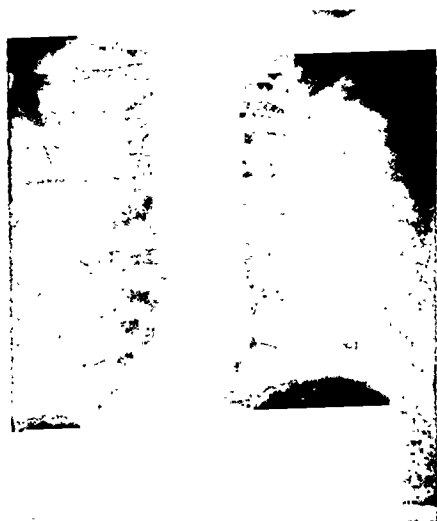


FIG. 418.—*Case 5.* Right chest from behind, showing tumour with definite outline and without evidence of pulmonary reaction around.

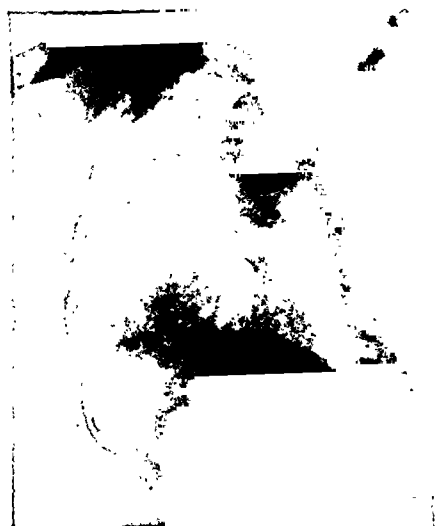


FIG. 419.—*Case 5.* Lateral view of chest.

bronchophony at right apex—front and back; dullness with diminished breath-sounds and vocal fremitus and resonance at the right base; in the right subelavicular region crepitations were present, accompanying bronchial breathing and associated with increased vocal resonance. There was considerable old dorsolumbar scoliosis, convex to the right. Urine examination: no tubercle bacilli found; albumin and casts present. Sputum examination (two occasions): tubercle bacilli not found; no fragments of growth detected.

X-ray Examination (*Figs. 418 and 419*).—The right diaphragm did not move well; there was evidence of fibrosis and excavation at the right apex; at the right base there was a large rounded shadow above the diaphragm—? cyst or new growth. It was regular and of moderate density, lying rather more posteriorly than anteriorly, without any evidence of reaction in the surrounding lung, and with an area of unaffected lung between the tumour and the hilum.

Artificial pneumothorax was attempted with a view to showing the relationship between the tumour and the lung, but proved impossible owing to adhesions between

the lung and the chest wall. Aspiration withdrew some blood and fibrin. The Wassermann reaction was negative, and the blood-count was comparatively normal. Ophthalmic examination disclosed loss of the upper half of the right visual field.

Exploratory thoracotomy was decided upon, with a provisional diagnosis of malignant disease.

OPERATION (March 4).—Under paravertebral anaesthesia with novocain 1 per cent, an oblique incision 7 in. long was made along the right 7th rib from the angle forwards; 6 in. of the rib were resected and the pleura was opened. There were fine adhesions between the lung and chest wall which were easily separated, and the condition shown in *Fig. 420* was disclosed. The major portion of the lower right lobe was filled with a firm nodular growth. The lobe was easily separated from the

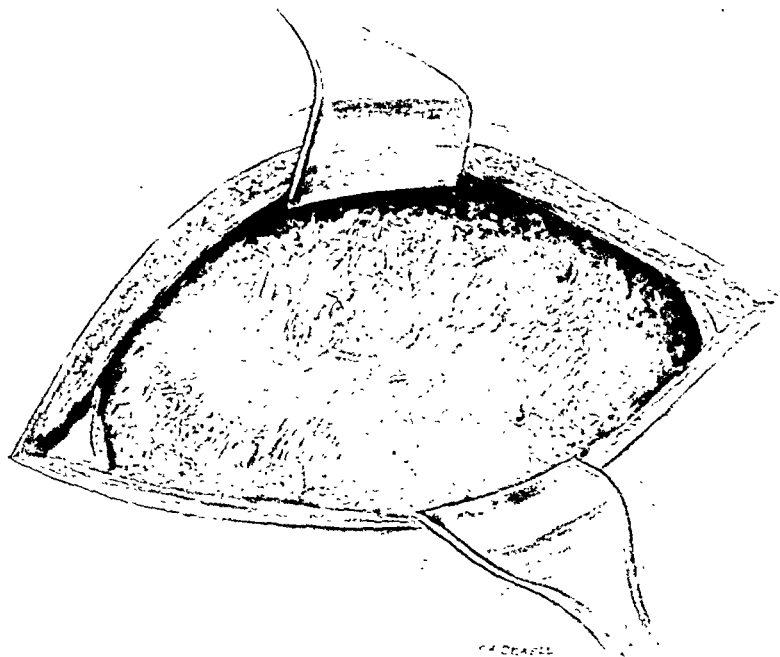


Fig. 420.—*Case 5.* Appearance on opening right pleural cavity after separation of fine pleural adhesions.

parietes and the mediastinum, but was firmly adherent to the diaphragm. The diaphragm was incised, and that portion 3 in. by 2 in. attached to the lower lobe was divided from the rest of the diaphragm. The deficiency was closed by suture. The lower pulmonary lobe, including the growth and the portion of attached diaphragm, was then partially withdrawn from the chest. The hilum was ligatured off by a series of ligatures and transfixing sutures after crushing the larger bronchi, and the mass removed. The chest wall was firmly sutured with an airtight tube *in situ*. This was clamped off and opened under fluid on the patient's return to bed.

The general condition of the patient at the end of operation was excellent, the pulse being regular, strong, and 90 per minute in rate. Apart from the period when the diaphragm was incised, when gas and oxygen was used for about four minutes,

the whole operation was completed painlessly with the paravertebral anaesthesia. For the following nine hours the patient was very comfortable, but after this time the pulse commenced to fail. Preparations were made for blood transfusion, but, before this could be done, air-hunger set in, with loss of consciousness and Cheyne-Stokes respiration, and the patient died rapidly.

POST-MORTEM EXAMINATION.—The right pleural cavity contained 20 oz. of blood. The right lower pulmonary lobe had been removed. No secondary deposits were present in the mediastinum or visible elsewhere. The bleeding had apparently resulted from puncture of an intercostal vessel during suture of the chest wall. There were tuberculous excavations of the apex of the right lung.

PATHOLOGICAL REPORT.—(Taken from the specimen in the Royal College of Surgeons Museum.) (Figs. 421 and 422.)—One half of a plexiform sarcoma



FIG. 421.—Case 5. View of lower lobe of right lung after removal. The cut bronchi can be clearly seen, and below the area of diaphragm attached to the tumour. No evidence of the growth can be seen from this aspect, showing that removal has been complete. ($\times 2$.)



FIG. 422.—Case 5. Naked-eye section through lower lobe of right lung showing growth involving major portion of lobe. At the upper part can be seen an area of normal lung. ($\times \frac{3}{4}$.)

removed by operation from within the chest. The tumour is irregularly rounded in form, and is composed of an opaque white, somewhat granular-looking tissue, having a striated character in places. It is adherent below to a portion of the diaphragm, and in the rest of its extent is surrounded by adherent lung. The section shows the tumour to be coarsely lobulated, and the upper lobule

the form of a flat rounded nodule showing marked vascularization at its periphery.

Microscopical Examination.—This shows the growth to be a plexiform sarcoma composed of broad, branching, solid columns of cells, many layers thick, and lying in a stroma of fibrous tissue. In many places the central part of the masses have undergone degeneration.

This case presents many interesting features: (1) The definite possibility of successful removal of a lobe of the lung containing growth, without serious shock, even in an old individual. (2) The fact that on occasions—rare, however, in the author's experience—growth may commence either in the lobe itself or in the periphery, and that it is possible in these cases to eradicate the disease completely in the early stages. (3) The value of local anæsthesia is well illustrated, as those parts of the operation on the chest wall and lung itself were absolutely painless, and only when there was interference with the diaphragm and its pleura was there any sensation.

In this case, in contrast to the others of this series, a portion of rib was removed for better exposure of the thoracic contents owing to the extreme rigidity of the chest wall in an aged individual, and especially in one the subject of advanced osteo-arthritis—the danger of damaging the intercostal vessels is self-evident. Another interesting point is the combination of a malignant growth and active tuberculosis, which has been previously described by many writers.

Lastly, although an airtight drainage tube was temporarily placed in the chest, no excessive bleeding occurred through this, showing either that it became blocked with clot or that it was obstructed by the expanding upper and middle lobes or by the rising diaphragm. In any case, it gave a feeling of false security as regards hæmorrhage, and hence delayed the use of such resuscitatory measures as blood transfusion until too late.

Case 6.—Teratoma of right lung. Removal: recovery.

Mrs. S., age 29, doctor's wife.

HISTORY.—Right basal pneumonia in November, 1920, followed by empyema which was operated upon on Dec. 6, 1920, one pint of pus being evacuated. This was performed at Portsmouth, and after a preliminary fall of temperature there was a rise again, accompanied by increase in the quantity of sputum. In February, 1921, aspiration was attempted without result. In April, 1924, the original wound was reopened and a small quantity of pus evacuated. The temperature generally became lower, but there was an evening rise. Pregnancy in 1922 terminated normally.

In the winter of 1924 there was a long spell of fever of three months' duration, followed by relief after the expectoration of over a pint of mucopurulent sputum within a week. Since March, 1925, there has been an evening pyrexia of 99° to 99·6°. Aspiration in March was negative. Several examinations of the sputum failed to show tubercle bacilli.

On Oct. 23, 1925, the case was referred to the author by Dr. R. A. Young as one of either interlobar empyema or pulmonary abscess. The X-ray showed a dark shadow in the right lung which was continuous with the mediastinal shadows. The central area was dark and surrounded by a lighter zone (*Figs. 423 and 424*). Lipiodol examination only showed very early bronchiectasis of the lower lobe.

OPERATION.—Thoracotomy was advised, and performed under intratracheal anæsthesia (Dr. Magill) on Nov. 1, 1925. A portion of the 6th rib was removed posteriorly and the pleura opened. Fine adhesions were easily freed, and the whole posterior part of the chest cavity and the interlobar fissures explored with negative result. The chest was then closed. An aspirating needle was inserted anteriorly, and a small quantity of (?) seropurulent fluid obtained. With the needle *in situ* a

portion of the third rib and costal cartilage was removed and the lung palpated. There was a firm thickened area in the hilum of the lung in close relation to the bronchi. Owing to the danger of opening main bronchi into the cavity, a firm pack was placed against the lung with a view to approximating the walls of what was considered to be an abscess of the hilar region.

Convalescence was uninterrupted, and the pack was removed on the fourteenth day. After healing, the sputum disappeared and the general health was very good. Subsequently, however, conditions returned to the *status quo*, and after further consultation another exploration was advised.



FIG. 424.—Case 6. Lateral view, showing tumour area lying about 1 in. below surface of anterior aspect of lung. The characters are the same as in Fig. 423.

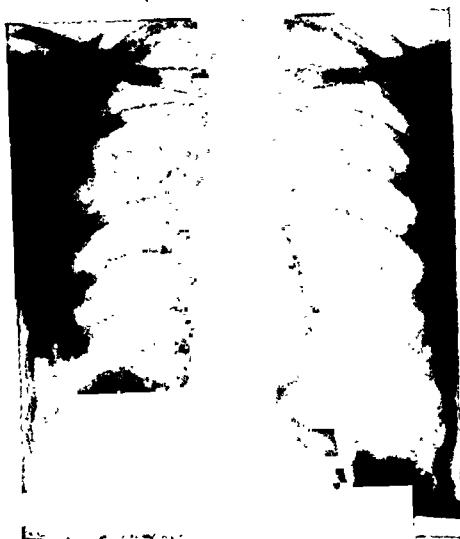


FIG. 423.—Case 6. Showing dark shadow extending outward from mediastinum into right lung. There is a small translucent area with a small dark mass in the centre. The sites of empyema drainage five years before, and of previous exploration, can be seen in the ribs.

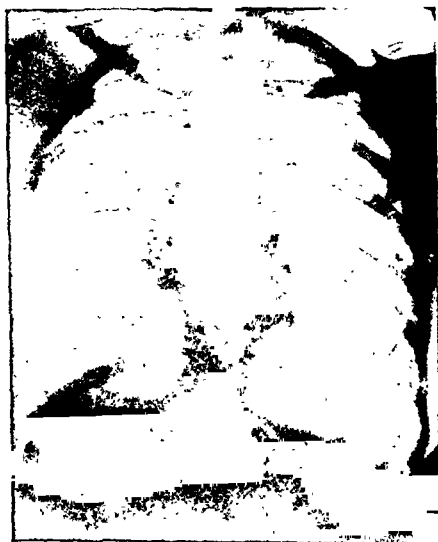


FIG. 425.—Case 6. Skiagram of chest about six weeks after operation.

SECOND OPERATION (May 20, 1926). —Intratracheal anaesthesia (Dr. Magill).

Anterior exploration was carried out through the original anterior incision. The lung adherent to the chest wall was incised through $\frac{3}{4}$ in. of collapsed tissue and a firm-walled swelling exposed. Further exposure was obtained by division of the 3rd and 2nd costal cartilages. The swelling, after negative aspiration and packing off of surrounding area, was incised, resulting in the escape of some sebaceous material and several hairs. The tumour was then recognized as a teratoma or dermoid, and was gradually enucleated

the tumour was then recognized as a teratoma or dermoid, and was gradually enucleated

from the surrounding lung. It was firmly adherent to the main bronchus of the lower lobe, and required careful separation. Extension occurred upwards towards the superior mediastinum, but the whole tumour was eventually delivered without any serious shock. The chest wall was completely sutured without drainage.

Reaction afterwards was comparatively slight, and the chest was aspirated of effused serum on two occasions. A slight leak of serum occurred through one of the stitch holes for a few days. The patient left the nursing home completely healed and convalescent one month from the day of operation (*Fig. 425*).

PATHOLOGICAL REPORT.—(Taken from the specimen in the R.C.S. Museum.) (*Fig. 426*.) The tumour is of flattened oval shape and measures 3 in. by 1½ in. The upper portion contains a cyst, from the wall of which several short hairs spring and which contained sebaceous matter. The cyst also contains a round firm body, which is attached by a long and narrow pedicle to its wall; this is of opaque white colour and is covered with corrugated skin. The lower part of the specimen is composed partly of solid tissue having the appearance of fibrous tissue, and of several cysts separated from one another by fibrous septa and mostly containing coagulated mucus.

Microscopical Examination.—

This shows that the wall of the larger cyst is lined with squamous epithelium and contains sebaceous glands and hair follicles. The pedunculated body and its pedicle consist of dense fibrous tissue covered with stratified epithelium. The smaller cysts in the lower part contain coagulated mucus and are lined by a single layer of cubical cells, in close relation with which are groups of mucous glands and in one situation an elongated bar of hyaline cartilage. In other parts the specimen exhibits spaces lined with columnar epithelium passing into squamous epithelium; and, in connection with the former, numerous mucous glands, lymph follicles, and layers of smooth muscle. Other spaces are lined with ciliated, columnar epithelium, and their walls contain mucous glands, small nodules of cartilage, and bundles of smooth muscle.

The tumour also contained vesicular structures suggesting thyroid tissue; and in places groups of tubular glands, among which are numerous giant cells.



FIG. 426.—*Case 6.* Appearance of cystic teratoma of lung removed from right lung and mediastinum. The upper part has been incised and shows parts of the contents. ($\times \frac{3}{4}$.)

In this case it is significant that the symptoms are all dated from an attack of pneumonia followed by empyema. On account of this the history was misleading and gave rise to a false conclusion, although even without this it would have been almost impossible to have made a correct pre-operative diagnosis.

The value of lateral skiagrams is illustrated by *Fig. 424*, where the clear zone can be more definitely seen to be nearer the anterior chest wall than the

posterior, and by this means suggests the better angle of approach for operative removal.

One other point of interest in this case is that the patient's father had had two superficial dermoids removed some years before.

Case 7.—Fibro-lipo-sarcoma of costovertebral angle. Removal: recovery.

Mrs. L. D., age 47, referred to the author by Dr. G. Basil Price, was admitted to Westminster Hospital on April 16, 1926.

HISTORY.—There were no points of any significance in the past history except that the patient had had a cough following dry pleurisy four years previously. The present trouble commenced with pain in the right chest ten months before. It was becoming gradually worse and more continuous, though it was not enough to interfere with sleep. Examination gave evidence of a patch of dullness and diminished breath-sounds over the right chest posteriorly in the region of the spine of the scapula and below.

ON EXAMINATION.—*X-ray Examination* showed an oval shadow in the upper part of the right chest just external to the vertebral column and overlying the



FIG. 427.—Case 7. Skiagram showing tumour in upper part of right chest.



FIG. 428.—Case 7. Lateral skiagram, showing tumour arising from region of costovertebral groove.

angles of the 5th, 6th, and 7th ribs at their posterior ends (Fig. 427). A lateral view shows the shadow to be within the chest cavity (Fig. 428).

Artificial Pneumothorax (April 22).—Artificial pneumothorax was performed and the lung partially collapsed. A skiagram showed the edge of the tumour beyond the lung edge above, thus proving it was extrapulmonary.

Thoracoscopy (April 26).—Thoracoscopy was performed and the instrument introduced below. The tumour could not be directly seen from this position, but a definite localized bulging of the lung was visible. The reason for this was disclosed at operation, where the lower part of the tumour was found covered by adherent lung.

OPERATION (April 29).—Intratracheal anæsthesia (Dr. Magill). The incision was made in the 7th intercostal space from the angles of the ribs forward to the axillary line. The pleura was opened, and the tumour seen lying in the costovertebral groove

(Fig. 429), as shown in the skiagrams. The 7th and 6th ribs were subperiosteally divided, but no portion of bone was removed. This gave considerable increase of

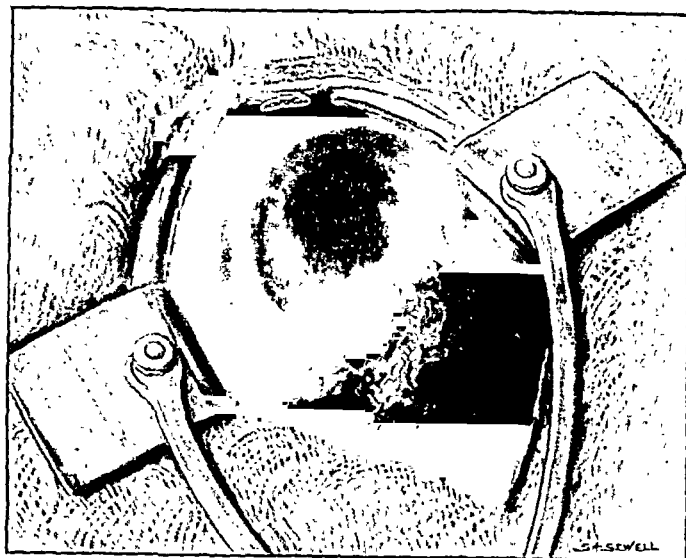


FIG. 429.—Case 7. Appearance of tumour and lung after exposure by intercostal incision and retraction of ribs. The lung has been slightly displaced downward and inward. The rib above has been divided in order to allow further retraction. ($\times \frac{3}{2}$.)

exposure without any division of the soft tissues. The adherent portion of the lung was separated from the remainder of the lobe and the raw area in the latter sutured.

The pleura on the outer side of the tumour was incised, and the tumour removed from its attachment to the 5th rib together with the adjacent periosteum. The pleural cavity was mopped dry and the chest wall sutured in layers, the lung being inflated by positive endotracheal pressure before tying the last suture. No peri- or pericostal suture was inserted, but the chest wall was firmly strapped over the dressings by overlapping strips in the manner adopted for fractured ribs.

Convalescence was rapid and uninterrupted except for the withdrawal of 5 oz. of blood-stained effusion on the fifth day. The patient was sitting up out of bed on the thirteenth day. A skiagram taken after operation is shown in Fig. 430.

PATHOLOGICAL REPORT.—(Taken from the specimen in the R.C.S. Museum.) The tumour is nearly circular in outline, $2\frac{1}{2}$ in. in diameter, smooth on the surface, except for a portion of adherent lung, and surrounded by a delicate fibrous capsule (Fig. 431). In the section it is seen to



FIG. 430.—Case 7. Skiagram of chest five weeks after removal of tumour.

consist of two types of tissue: a central dense mass having the appearance of hyaline fibrous tissue, and irregular, opaque, buff-coloured areas of softer consistence,

which are in places divided up by narrow hyaline tracts. The result of staining with Sudan III is shown in Fig. 432.



FIG. 431.—Case 7. Appearance of tumour after removal. Note portion of adherent lung removed with tumour.



FIG. 432.—Case 7. Appearance of tumour stained with Sudan III to show fat.

Microscopic Examination (Fig. 433).—This shows the growth to be a lipo-fibro-sarcoma. It consists partly of areas of closely-packed spindle cells, partly of areas of small polyhedral cells and extensive tracts of fat cells of an embryonic type, the

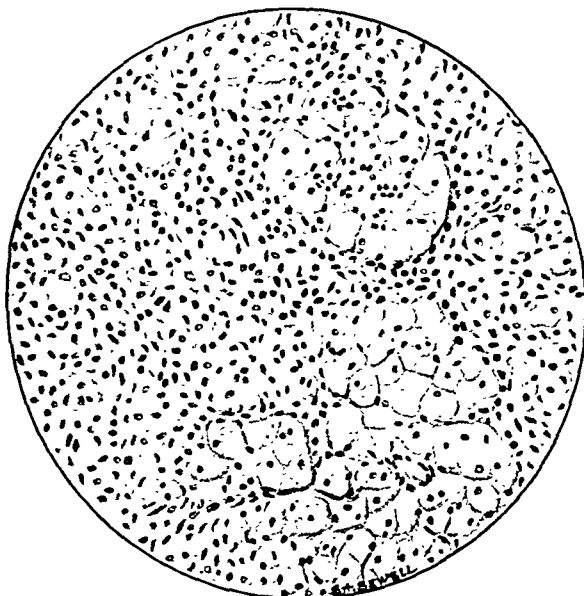


FIG. 433.—Case 7. Microscopic appearance of tumour. ($\times 275$.)

fat being in the form of minute granules within the protoplasm. In the central parts of the tumour there is a large admixture of fibrous tissue.

In this case the diagnosis of the cause of pain and the situation of the tumour with its relationship to the lung was evidenced by skiagrams in different directions before and after artificial pneumothorax. Thoracoscopy was not so helpful, but would probably have been of more value if the site of introduction of the instrument had been higher. The appearance of the tumour at operation certainly suggested a benign growth, as it was only attached to a small portion of the rib of origin and came away comparatively easily. The microscopic appearances indicate a relatively small degree of malignancy, and therefore the prognosis would appear to be good. X-ray examination at the end of six months shows a normal chest.

SUMMARY.

1. A series of seven operable intrathoracic growths is recorded.
2. Of these, six have recovered and have apparently been cured.
3. One patient in whom death occurred illustrates the possibility of primary lobectomy in suitable cases. Also the risk of damaging the intercostal vessels is shown, especially when rib resection is used as a method of approach. Lastly, the case shows that intrapleural hæmorrhage may occur even in the presence of drainage without giving rise to any external evidence.
4. The value of operations in more than one stage is shown in two cases.
5. Endotracheal anæsthesia should be used where the pleura is free, but gas and oxygen by the ordinary method is better where adhesions are present.
6. The value of adequate X-ray examination is emphasized. Where possible, artificial pneumothorax should be done both as a diagnostic method and as a preliminary to operation, because the operative shock of opening the free pleura is reduced to a minimum in its presence.
7. Thoracoscopy, bronchoscopy, lipiodol injection, and bismuth-meal examination of the œsophagus may all prove valuable adjuncts to diagnosis and to subsequent treatment.

In conclusion, the author tenders his thanks to those physicians who have referred their cases to him, and for their kind help and advice in treatment. To Dr. Stanley Melville and to Dr. W. H. Coldwell is also due much gratitude for the excellent skiagrams and their reproduction, without which the results attained would not have been possible; and last, and by no means least, to Dr. I. W. Magill for his great skill and judgement in the administration of the anæsthetics in the whole series of cases.

SOLITARY CYSTS OF THE KIDNEY.

By ANDREW FULLERTON, C.B., C.M.G., BELFAST.

SOLITARY cysts of the kidney are rare. Young,¹ of Baltimore, for example, in his *Practice of Urology*, says, "there has not been a case discovered among the 12,500 at the Brady Institute". Cases do, however, crop up from time to time, and in recent years several papers have appeared on this subject. Kretschmer,² Harpster³, Swartz⁴, and Smith⁵ have each published cases and discussed the diagnosis and treatment in the light of modern methods. Harpster, in describing two cases, reviews the literature and brings the number of reported cases up to 95. He has, however, omitted Kretschmer's case, which, with those more recently reported by Swartz and Smith, and the one about to be described, makes a total of 99.

The following case was recently under my care:—

Mrs. S., age 45 years. Family history unimportant. The patient has always been healthy and has had three children, the last three months before being seen by me. About a month after the last child was born the patient felt giddy while out walking. About a fortnight later she complained of a choking feeling and became very collapsed. Her medical attendant, Dr. G. G. Lyttle, of Belfast, attributed her symptoms to heat exhaustion, but made a careful physical examination of the patient, when an unexpected swelling was discovered in the right lumbar region. I saw her on July 26, 1926, and found a large, smooth, reniform, elastic, movable swelling, about half the size of a melon, in the right lumbar region. The patient did not complain of pain on firm pressure over the tumour: she was, in fact, unaware of its existence. The urine was examined and found to be free from abnormal constituents: there was no frequency and no history of hæmaturia. Cystoscopy was carried out on July 29. The urine collected through the cystoscope was clear amber, acid, free from albumin and sugar, but showed on microscopical examination a few red blood-cells, probably due to the trauma of the instrument: pus was absent: the bladder and ureteral orifices were normal. Catheters were easily introduced into the ureters and passed without difficulty the normal length toward the kidneys. Specimens were obtained from both kidneys: the flow on the right side was much freer than on the left—nearly twice as much in a given time. Even allowing for possible leakage by the side of the catheter, there appeared to be a decided diuresis on the affected side. Three samples were taken from each catheter, and the specific gravity estimated by glass beads. The first and second were similar, 1010 on the right side as against 1015 on the left; the third sample showed a specific gravity of 1005 on the right as against 1015 on the left. The diagnosis of a renal tumour, probably a cyst, was made from the situation, consistency, and shape of the tumour, and the difference in the flow and specific gravity of the urine on the two sides.

OPERATION (Sept. 20).—The right kidney was explored through a lumbar incision, and, being found to contain a large cystic swelling and several small cysts, was removed. The kidney, on removal, showed the following: Occupying the upper pole was a large cyst, somewhat lobulated on its surface, but apparently single, with very thin, transparent walls, almost like tissue paper, over which coursed small, thin vessels (*Fig. 434*). It measured 3 in. \times 2½ in. \times 2½ in. The capsule was thickened, and closely adherent to the perirenal fat. At the adherent parts it was opaque and white. Scattered over the cortex were several very minute cysts,

varying in size from that of a hemp-seed to that of a small pea. The ureter and pelvis were normal in appearance, and there was no connection between the cyst and the calices or pelvis. As it was desired to preserve the specimen, the kidney was not damaged by dissection, but some of the fluid was withdrawn by a syringe, the needle of which was passed through the substance of the kidney into the cavity of the sac. The fluid was straw-coloured, with a slight haze, had a specific gravity of 1015, became almost solid on boiling, and contained 0.5 per cent of urea. On microscopical examination a few red blood-cells were found, but no other cellular deposit. The fluid was sterile on direct examination and on culture. The blood-cells probably came from the kidney through which the needle had been passed to obtain the fluid.

A microscopical examination was made of one of the small cysts—the main cyst, being destined for museum purposes, was not interfered with. The parenchyma of the kidney in the neighbourhood of the small cyst was somewhat compressed and showed slight chronic inflammatory changes in the form of small round-celled infiltration. The wall of the cyst was formed by connective tissue without any demonstrable epithelial lining.

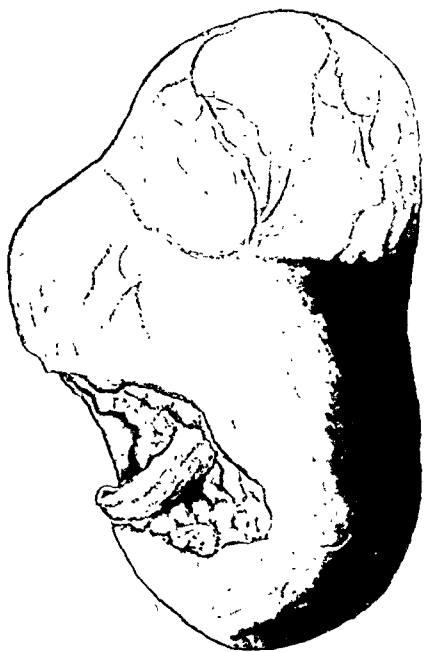


FIG. 434.—Solitary cyst of the kidney.
Condition seen on removal of the organ.

Solitary serous cysts and solitary hæmorrhagic cysts appear to belong to a different category. Begg,⁶ in reporting a case of the latter, holds that this condition is totally different from the solitary serous cyst. He says, "Large, solitary, hæmorrhagic cysts are excessively rare. They have few characteristics in common with solitary simple cysts, and should be placed in a different category". He suggests that solitary hæmorrhagic cysts "are of the nature of partial hæmatonephroses, where the source of the bleeding remains active over a long time. This source may be in the papillæ of the involved portion of the pelvis, and in the case reported an angioma was demonstrated". According to this view hæmorrhage into a solitary

serous cyst does not constitute it a true hæmorrhagic cyst. The present article will deal only with solitary serous cysts.

Etiology.—Three views are held: (1) That they are due to embryonal rests; (2) That they are due to failure of union between the glomeruli and the collecting tubes; and (3) That they are retention cysts, due to constriction of the tubules by fibrous tissue or blocking of the glomeruli or tubules by desquamated and degenerated cells, favoured perhaps by small hæmorrhages. The view that finds most acceptance is that they are retention cysts, due to constriction of the tubules by sclerosis following chronic inflammatory changes. The fact that small cysts, indistinguishable from those seen in chronic interstitial nephritis, are sometimes found in the affection under discussion lends support to this view.

Pathology.—The cyst arises from the cortical portion of the kidney. It approaches the surface of the organ and thins out the cortex, which, with the capsule, forms the cyst wall. The latter may be lined on its inner surface by a delicate layer of cubical or flat epithelium, but this lining is absent in many cases. The contents of the cyst consist of a clear serous fluid in which small quantities of urea, and occasionally blood, may be found. The cyst very rarely communicates with the calices or pelvis of the kidney, though, when large, it may encroach upon these cavities, from which it is separated by a thin membrane.

Situation and Size.—

Situation.—The cyst is usually found on one side of the body only, and is situated, as a rule, at one of the poles of the kidney. In Harpster's series of 95 reported cases, 39 were in the upper pole, 20 in the lower pole, 6 on the convex border, 2 were in horseshoe kidneys, and in 28 the site was not stated. In Kretschmer's case the cyst was in the lower pole, in Swartz's in the lower pole, and in the present case in the upper pole.

Size.—These cysts vary in size from that of a hazel-nut to that of a man's head, or even larger.

Age and Sex Incidence.—

Age.—Most of the reported cases were in patients between the ages of 30 and 60 years. Four cases in Harpster's list were in children, two were 1 year old, one was 4, and one 8 years. The oldest patient was a male, age 89 years, under the care of Bockenheimer, who successfully resected a cyst from a horseshoe kidney.

Sex.—The condition is more frequent in females. Of the 99 recorded cases 28 were in males, 58 in females, and in 13 the sex was not stated.

Associated Abnormal Conditions.—Complicating these cysts the following have been found: hypernephroma, carcinoma of the kidney, malignant papilloma of the renal pelvis, horseshoe kidney, abnormalities of the renal blood-vessels, bifid pelvis, hydronephrosis and renal calculus, and tuberculosis of the kidney.

Side Affected.—In the 99 cases the right side was affected in 44 and the left in 38. In 17 the side was not stated.

Symptoms.—Symptoms may be entirely absent, as in the present case. A tumour in the abdomen may be accidentally discovered by the patient or his medical attendant. If the swelling is large it may exert pressure on the diaphragm or abdominal contents, giving rise to dyspnoea or gastro-intestinal symptoms. Pain, when present, may be constant or intermittent, and may be confined to the kidney region or radiate to the groin, testicle, or thigh. Typical renal colic, with vomiting, may be complained of. The urine may be perfectly normal, as in the case under review. Rarely, blood, and, still more rarely, pus, may be found in it.

Diagnosis.—An abdominal tumour, suspected as being of renal origin, is capable of being thoroughly investigated by the newer methods of diagnosis. A skiagram may be negative or may show an outline of the affected kidney. Pyelography will differentiate between hydronephrosis and cysts. In the former the enlarged pelvis and calices are easily recognized after the injection of an opaque solution such as iodide of sodium. Solitary cysts, according to

Bransch and Carman,⁷ may give rise to the following changes: (1) Shortening of the adjacent calices; (2) Flattening of the nearest portion of the true of the pelvis; and (3) Changes in the axis of the kidney caused by the weight of a cyst seated at either pole. A normal pyelogram will not wholly exclude the presence of a cyst, which may be so situated as not to deform the pelvis. As a rule it is possible to distinguish solitary cysts from neoplasms of the kidney and polycystic kidney by the type of distortion of the pelvis and calices. In the present case the diagnosis of a localized cystic swelling of the kidney seemed so obvious by other methods of examination that pyelography was not resorted to. Alterations in the function of the affected kidney, when compared with its fellow of the opposite side, may give valuable information. In the present case an abundant flow of urine, with a specific gravity of 1010, dropping later to 1005, on the affected side, as compared with a more scanty flow of urine with a specific gravity of 1015 on the sound side, was considered sufficient to settle the diagnosis of an affection of the kidney as opposed to a tumour of another organ or one outside the kidney. This 'unilateral diuresis' has been found in tubercle of the kidney, renal calculus, pyelitis, tumours of the kidney, hydatid cysts of the kidney, and injuries to the kidney.^{8,9} A specific gravity of 1010 was, moreover, considered too high to be that of the urine of a hydronephrotic kidney of sufficient size to produce the tumour found on physical examination. A large hydronephrosis is likely to be attended with urine of a much lower specific gravity than 1010. The usual specific gravity of the urine of a hydronephrotic kidney of the size of the organ here described would be 1005 or lower. The fact also that the specific gravity of the urine for the affected kidney varied from 1010 to 1005 during the examination showed, I think, that there was good functioning capacity on that side, as my experience goes to show that a badly damaged kidney has little or no range of concentration or dilution, but secretes fluid of almost uniform concentration throughout the examination. This examination further excluded such affections as distended gall-bladder, cyst of the liver, ovarian cyst, and other tumours not connected with the kidney. The elasticity of the swelling, as felt on abdominal examination, was strongly suggestive of fluid imprisoned in the kidney. The absence of the lobulation so characteristic of polycystic kidney was sufficient to exclude that condition. Hydatid cyst was negatived on account of its extreme rarity in people who have lived all their life in Ireland. Chromocystoscopy is another method of diagnosis that has been used, and would prove useful in deciding on the kidney as the seat of the affection, should any difference on the two sides be apparent.

Treatment.—Various methods of treatment have been employed, including puncture, incision and drainage, enucleation of the cyst, cuneiform resection, and nephrectomy. Puncture and incision have been abandoned. Enucleation is liable to leave uneven surfaces difficult to approximate with any prospect of satisfactory union and rapid healing. Cuneiform resection is the method of choice in a suitable case. A wedge-shaped piece of the kidney, including the cyst, is removed, and the cut surfaces are brought together with strong catgut. This operation was first carried out by Tuffier, and has been performed by Moynihan, Mazzoni, Semb, and others. Nephrectomy

SOLITARY CYSTS OF THE KIDNEY 1

will be required when the cyst is large and involves a large area of the kidney, or when other cysts are present. In the case now recorded it was considered wise to remove the kidney on account of the presence of other cysts and of immature forms capable of growing to a large size.

I am indebted to Miss Rea, of the Anatomical Department of Queen's University, Belfast, for the accompanying drawing.

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SOME OBSERVATIONS ON THE BONE CHANGES IN RENAL RICKETS.*

By E. P. BROCKMAN, LONDON.

THE presence in children of chronic interstitial nephritis associated with bone changes somewhat resembling those seen in rickets has, of recent years, been described by a number of observers under the name of 'renal rickets'. Recently Dr. Hugh Barber¹ has written an account of the clinical features of this condition, which he based upon his personal observations of seventeen patients. The observations put forward in this paper are concerned, not with the clinical features of the condition, which in my patients were similar to those which other writers have recorded, but rather with the X-ray appearances and histological changes that are seen in the bone, at the same time comparing these latter with the histological picture of normal bone and rickets.

CASE REPORTS.

Case 1.—A boy, age 14. When 2½ years old he suffered from an attack of acute nephritis. Up to the age of 7 he had repeated vomiting, for which his mother could furnish no cause. When he was 13 he began to complain of pains in his knees and to develop the deformity of genu valgum. This gradually increased until the time he came under observation, when there were eight inches of separation between the internal malleoli. At this time he was passing 50 to 60 oz. of pale urine daily, and his blood-urea was 102 mgrm. per 100 c.c. of blood. His muscle power was good, and there was no other bony deformity. The skiagrams of his bones (*Fig. 435*) illustrate, I believe, the typical condition as seen in renal rickets: (1) The changes affect principally the bone in the region of the growth disc. (2) The epiphysis itself is not markedly changed from the normal. (3) The diaphysis is slightly widened, but not to the extent seen in rickets. (4) The diaphysis in connection with the growth disc is not cupped in the same way as in rickets, but there is an irregular area of bone formation. (5) There is a marked increase in the depth of the non-ossified area between the epiphysis and diaphysis. (6) There is no obvious osteoporosis. (7) The shafts of the long bones are not affected in the way observed in rickets, there being no increase of the normal curves with supporting struts of periosteal bone.



FIG. 435.—*Case 1.* Skiagram of wrist showing typical changes in early renal rickets.

* From the Orthopaedic Department, St. Thomas's Hospital. Read before the British Orthopaedic Association, October, 1926.



FIG. 436.—Case 2, 1925. Skiagram of wrist showing advanced changes, the epiphyses being displaced from the shafts of the bones.

Case 2.—A girl, age 11, who, when 3 years of age, had an attack of acute nephritis which failed to clear up, and subsequently developed into a chronic condition. She was under treatment from 1918 to 1925, when she died of uræmia. Early in 1923—five years after she first had nephritis—she began to develop knock-knees, this gradually increasing in extent. Between July, 1920, and March, 1922, her blood-urea rose from 35 mgrm. to 162 mgrm. per 100 c.c. The skiagrams taken in 1925 show similar changes to those in *Case 1*, with the addition that in the wrist there is a displacement of the epiphyses of the radius and ulna (*Fig. 436*). At the lower end of the femur the epiphysis is also displaced backwards (*Fig. 437*). The only skiagram I possess taken at an earlier date is one of the knee-joint in 1924 (*Fig. 438*). In this it will be observed that the epiphysis of the femur is already displaced backwards, and that the line of ossification of the upper end of the tibia and fibula is apparently normal. Comparing this skiagram with the one taken twelve months later, it will be noticed that: (1) The non-ossified area between the epiphysis of the femur and the irregular bone formation has increased very markedly in width. (2) The irregular bone has increased in extent. (3) There has been some absorption of the bone at the lower end of the shaft. (4) The line of ossification at the upper end of the tibia and fibula is now involved. (5) There is a marked osteoporosis.



FIG. 437.—Case 2, 1925. Skiagram of knee (lateral view). Note displacement of epiphysis of femur and irregular bone formation.

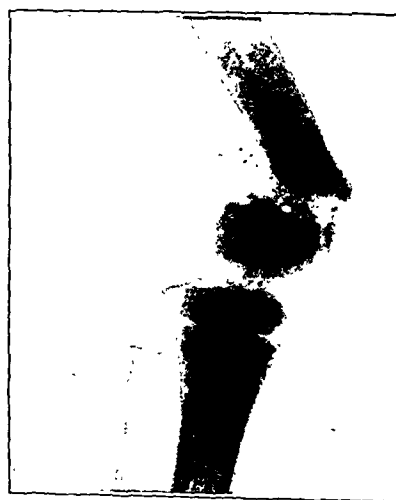
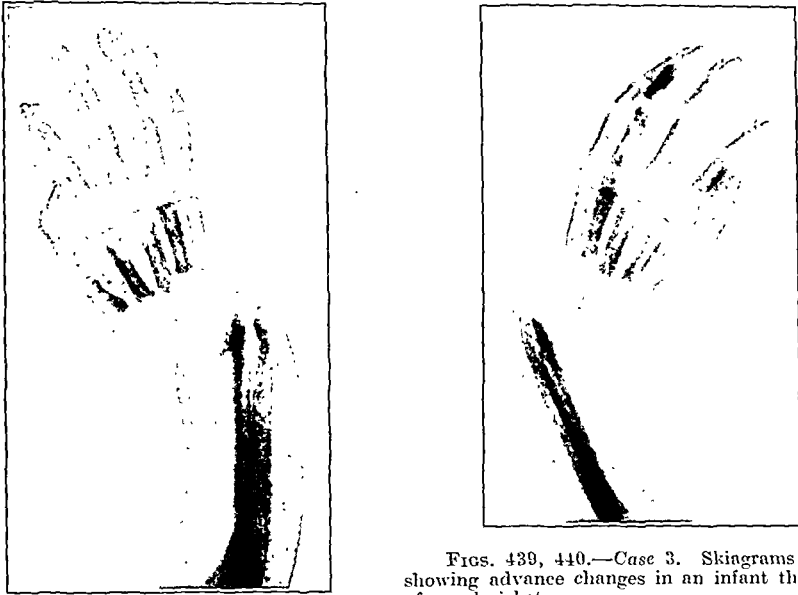


FIG. 438.—Case 2, 1924. Earlier skiagram. Epiphysis already displaced but changes not advanced. Compare with *Fig. 437*.

Case 3.—A boy, age 13 months, who was admitted for the treatment of rickets. He had been fed upon a variety of artificial foods, all of which he vomited. His

growth had been normal until the age of 6 months, when his mother said he seemed to stop growing and she noticed that his right foot was turning inwards. He was a small child for his age, was very wasted, and had marked deformities of both upper and lower limbs, the hands being radially adducted (*Figs. 439, 440*) and the feet twisted inwards. The tibiae showed no increase of their normal curve. He had well-marked beading of the ribs, and swellings rather similar to those of rickets at the wrists and ankles. The skiagrams demonstrate very well that these deformities



FIGS. 439, 440.—Case 3. Skiagrams of wrist showing advance changes in an infant the subject of renal rickets.

are not due to any alteration in the shafts of the bones, but to dislocation of the epiphyses. At the lower ends of the radius and ulna the most recently formed bone is splayed out. The lower end of the tibia shows a similar condition (*Fig. 441*). There is a marked osteoporosis of all the bones.

EXAMINATION OF SPECIMENS.

It was from *Case 3* that my pathological material was obtained. The body was very wasted and there was little subcutaneous fat. All the organs except the kidneys appeared normal. The suprarenals, which Ashcroft states had undergone changes in one of his patients, were normal both macroscopically and histologically. I removed the left tibia and fibula.

The Kidneys.—These were both excellent examples of the condition known as congenital cystic disease. Their surfaces were composed almost entirely of fairly large opalescent-coloured cysts (*Fig. 442*). The walls of the ureters were not thickened, and a fine probe could be easily passed along them. Divided in half, one of them showed, in addition to the cysts which were present throughout its substance, a thin cortex and atrophied medulla.

Histological examination demonstrated the changes of chronic interstitial nephritis (*Fig. 443*): (1) The glomeruli are fibrosed and the capsule is surrounded by fibrous tissue. (2) The tubules are dilated and cystic. (3) There is a large quantity of fibrous tissue throughout the substance of the kidney. (4) The small arteries show an advanced degree of endarteritis. (5) There is evidence of active inflammation in the presence of areas of mononuclear cells.



FIG. 441.—Case 3. Showing similar changes in the lower limbs.

The walls of the cysts on the surface are quite different in their structure from those formed by dilatation of the tubules, being composed of plain muscle-fibres (*Fig. 444*). This particular section was taken from an isolated cyst on the surface of the kidney which can hardly have had any connection with the pelvis, the only part of the kidney which normally has plain muscle-fibres in it. It is rather difficult to account for the presence of this muscle tissue; but one possible suggestion is that the cyst originated from a lymphatic space which has become occluded by the fibrous changes taking place in the substance of the kidney.

The Tibia and Fibula.—The shaft of the tibia (*Fig. 442*) was quite straight. The lower epiphysis was loosened and displaced inwards. The bone was very soft, being easily split with a scalpel. The periosteum was

not thickened. The bone exhibits a very thin cortex, with the lower epiphysis displaced inwards and an area of hæmorrhage between it and the diaphysis. The inner part of the end of the shaft has been absorbed, and the outer part is not connected by bone to the epiphysis, but by fibrous tissue and the periosteum. The upper epiphyseal line, though quite unlike that of rickets, is not as sharp as the normal. The medulla shows a large increase in its fat content.

In order to obtain for comparison evidence as to the differences from the normal and from rickets that are present in this specimen, examples were taken

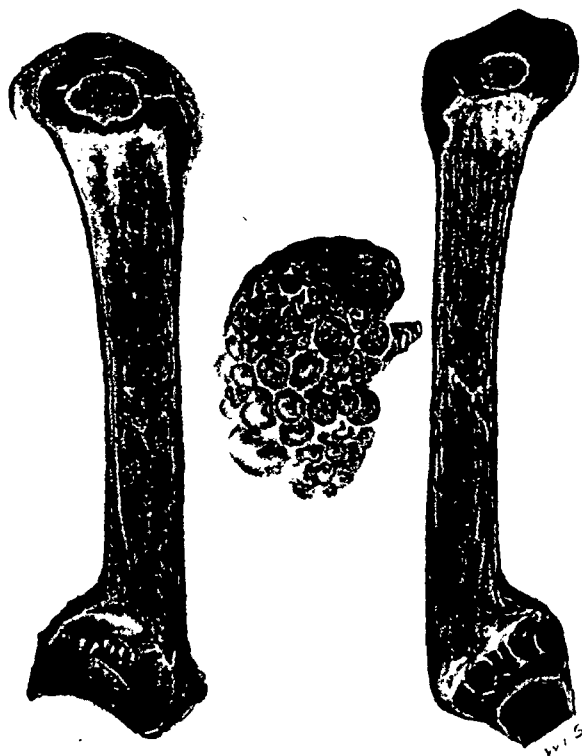


FIG. 442.—Tibia split longitudinally: shows the displaced lower epiphysis, area of hæmorrhage in relation to it, and fatty marrow. Kidney with multiple cysts on its surface.

from children of approximately the same age. The normal tibia from a child 14 months old was much harder and had to be divided with a saw. It exhibited a good thick cortex, regular epiphyseal lines, and a good red marrow. The tibia from the patient with rickets split fairly easily with a scalpel. It had an increase of the normal tibial curve, a thickened periosteum, irregular epiphyseal line, and a more vascular marrow, which also had an increase over the normal in its fat content.

Histological sections demonstrating the normal bone, rickets, and renal rickets were prepared.

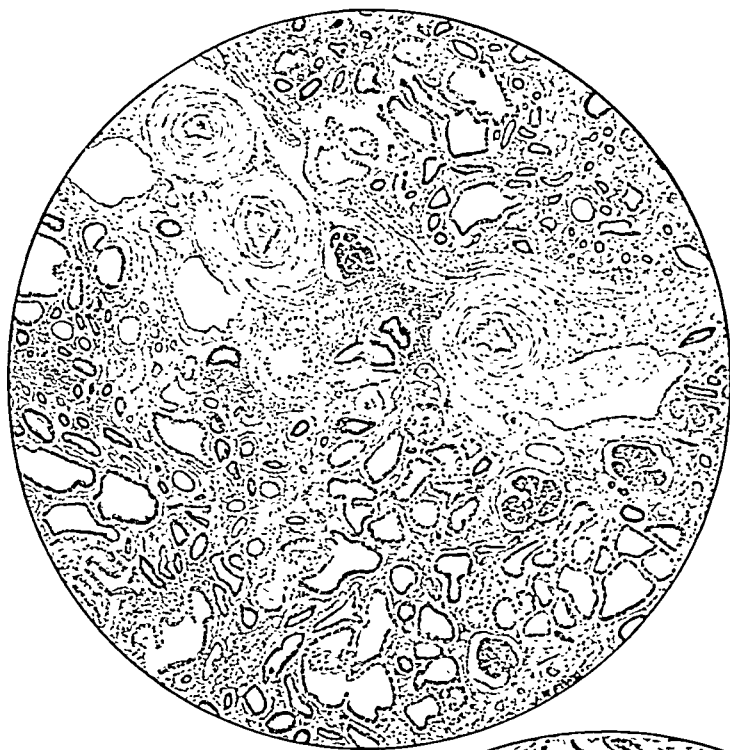


FIG. 443.
Section of kidney,
showing the marked
degree of endarteritis
of the vessels and the
severity of the chronic
nephritis.

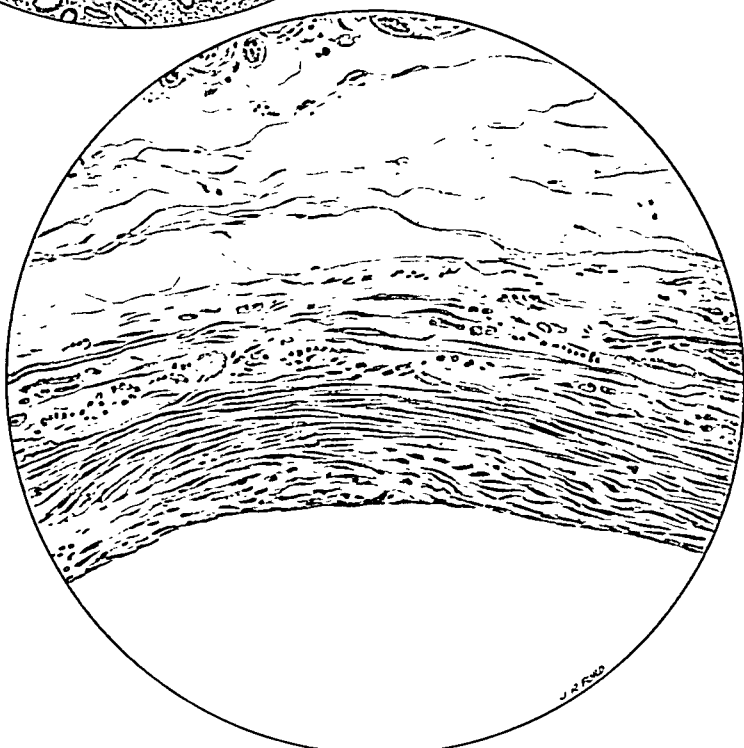


FIG. 444.
Section of cyst wall
on surface of kidney.
Note the plain muscle
fibres composing it.

Normal Bone.—A section taken through the upper growth disc of the tibia (*Fig. 445*) shows the normal process of ossification taking place. The line of ossification is a regular one. The cartilage cells are arranged in columns. There are regular trabeculae of ossifying bone with the osteoblasts arranged in order, and a normal red marrow.

Rickets.—A section taken through the upper growth disc of the tibia (*Fig. 446*) shows a very irregular line of ossification. Some of the cartilage cells, although arranged fairly regularly in columns, have failed to undergo



FIG. 445.—Normal bone: line of ossification in the upper end of the tibia.

calcification and ossification. There is an increased number of blood capillaries which are extending into the cartilage. The trabeculae of bone are very irregular in comparison with the normal. The red marrow in relation to these bony trabeculae has been replaced by a very cellular fibrous tissue.

Renal Rickets.—A section taken through the growth disc at the upper end of the tibia (*Fig. 447*) demonstrates very striking changes: (1) The red marrow is replaced entirely by fat. (2) There is an almost entire destruction of the regular columns of cartilage cells. (3) Active absorption of bone already formed by osteoclasts. (4) Little formation of new bone. (5) The whole area which normally should be occupied by columns of cartilage cells and bony trabeculae is filled up with fibrous tissue. (6) There is an increase from the normal in the number of blood capillaries in this area.

FIG. 446.

Rickets: line of ossification in the upper end of the tibia. Note its irregularity.



FIG. 447.

Renal rickets: line of ossification in the upper end of the tibia. Note the replacement of red marrow with fat, destruction of the cartilage cells, masses of fibrous tissue, and the large number of blood capillaries.

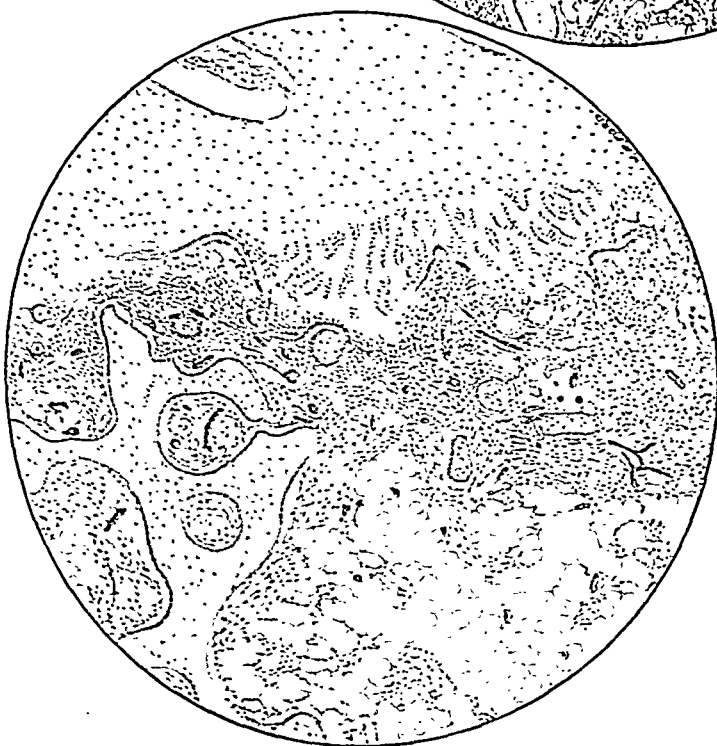


Fig. 448 is a portion of the previous section under a higher power; it shows an area of calcifying cartilage surrounded by a cellular fibrous tissue, a few cartilage cells, and an increased number of capillaries.

Fig. 449 is a transverse section through the fibula; it demonstrates a similar condition. The red marrow is very largely replaced by fat. There is in the bone canals a similar condition, and the formation of fibrous tissue replacing the bone which has been absorbed. The small arteries of the medulla show thickening of their walls. *Fig. 450* shows one of these vessels under a

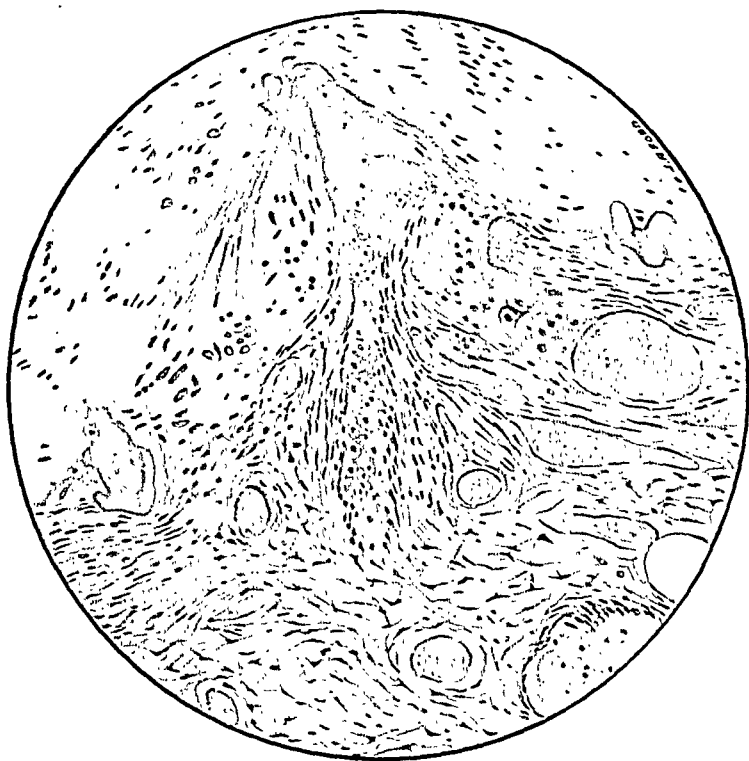


FIG. 448.—Renal rickets: portion of previous section under a higher magnification.

high power. The muscular coat is markedly thickened, and there is a degeneration of the endothelial cells lining it, which are large and highly vacuolated.

Fig. 451 is a section taken through the tissue in contact with the lower tibial epiphysis; it shows an entire absence of bone and a large organizing clot containing a quantity of old blood pigment.

Longitudinal sections through the shaft of the tibia demonstrate the presence of large numbers of well-formed osteoclasts lying beneath the periosteum, between it and the bone, which are actively absorbing bone. †

Comparing the changes that we find in renal rickets with rickets and the normal bone, we observe:—

1. The shafts of the bones in renal rickets are straight, and the deformities

FIG. 449.
Renal rickets :
transverse section
through the fibula.
Note the partial re-
placement of red
marrow with fat,
and the thickening
of the vessel wall.

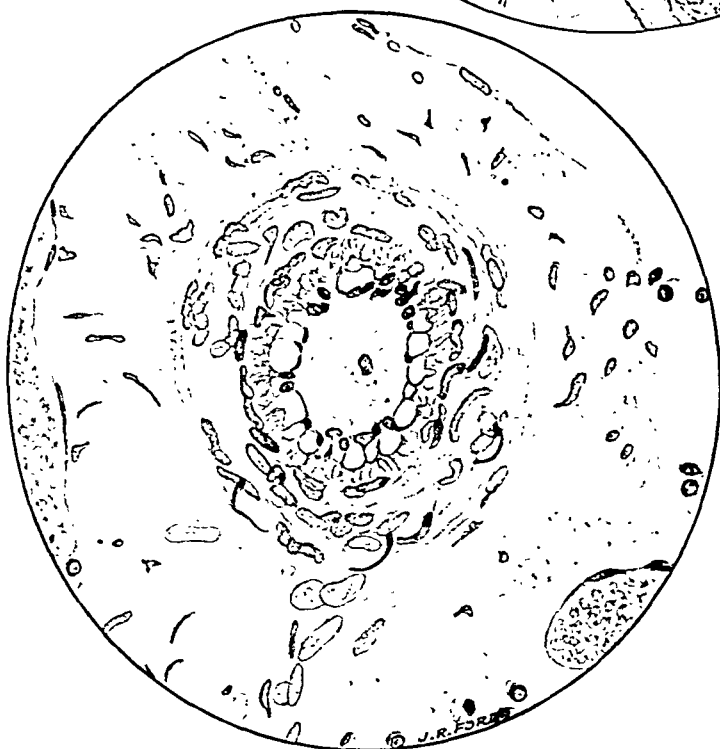
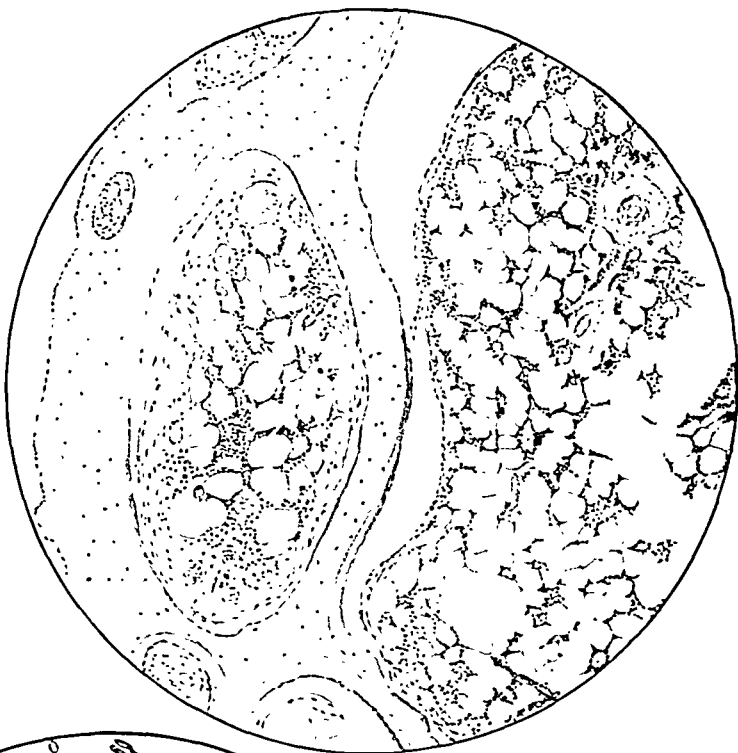


FIG. 450.
Renal rickets :
vessel in medullary
cavity of fibula under
higher magnification.
Note the thickening
of the muscular coat,
and degeneration of
the endothelial cells.

when they develop are not, as in rickets, due to an increase of the normal curve, but are the result of separation and displacement of the epiphyses. This displacement is seen most markedly at the lower ends of the femur, tibia, radius, and ulna. The direction in which the epiphyses are displaced is, I think, governed by the pull of the muscles in relation to them.

It is not desirable to correct the deformities by osteotomy, primarily because of the danger of uræmia following the anæsthetic, and also the



FIG. 451.—Renal rickets : section of old hæmorrhage in relation to the lower epiphysis of the tibia.

deformity tends to recur. The deforming process—actual solution of continuity in the neighbourhood of the growth disc—is progressive, and the deformity has been known to recur after correction.

2. The red marrow is replaced by a fat marrow, more advanced in some bones than in others.

3. There is very little bone formation.

4. There is active bone absorption by osteoclasts both in the neighbourhood of the growth disc and also of the shaft of the bone beneath the periosteum.

5. Replacement of the absorbed bone by fibrous tissue. In rickets there is a quantity of fibrous tissue laid down among the trabeculae of bone which have been formed, but in renal rickets it is very much increased in extent.

6. Thickening of the walls of the arteries in the medulla, with degeneration of the endothelial cells lining them.

7. An increase in the number of capillaries in the region of the growth disc as compared both with the normal and with rickets.

It appears that chronic interstitial nephritis has always been in existence in these patients for a long time before they develop any deformities and the changes become manifest in the skiagrams; also that these changes are progressive and appear in some bones before others. The lower ends of the long bones apparently are involved before other situations. It is reasonable, therefore, to suppose that they are in some way dependent upon the failure of the kidneys to carry out their function.

The severity of the nephritis as shown by the section of the kidney is very obvious, and there appears to be very little normal gland left to carry out its functions. I would suggest as a hypothesis that this failure on the part of the kidney allows a toxic condition to arise which influences adversely the delicate cells in the region of the growth disc and also the cells of the red marrow; and also that in the former their place is taken by fibrous tissue for the most part, and in the latter by the deposition of fat. In the section of the tibia the red marrow is almost entirely so replaced, but in the fibula this has not advanced to such a degree, showing that the condition is a slowly progressive one.

There is no evidence that the nephritis in these children is due to an ascending infection of the ureters, nor that it is related to nutritional changes, though the latter is a possible hypothesis. Another possible suggestion is that, whatever the factor which produces the chronic nephritis may be, it also subsequently causes the bone changes to take place.

I desire to express my thanks to Professor L. S. Dudgeon and Dr. A. L. Urquhart for their assistance and advice in the preparation of this paper.

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A CASE OF B. WELCHII CHOLECYSTITIS.

BY E. PEARCE GOULD AND L. E. H. WHITBY, LONDON.

THE patient, a married woman, age 43, with two children, was admitted to the Middlesex Hospital on November 7, 1926. She gave a vague history of slight indigestion for the past few months. Two days before admission she was seized with sudden severe pain in the right upper abdomen. On the day before admission she vomited twice.

ON EXAMINATION.—The patient's temperature when first seen was 99°, pulse 100, and her respirations were 28. She appeared to be in considerable pain, chiefly in the right upper quadrant of the abdomen, but also extending down to the right iliac fossa. There was no rigidity of the abdominal muscles, and the respiratory movement of the abdominal wall was free and equal on the two sides, but a deep inspiration produced exacerbation of the pain beneath the right ribs. Deep palpation in this area elicited tenderness beneath the right costal margin, with reflex local contraction of the abdominal muscles. Nothing abnormal was detected on pelvic examination. There was no jaundice, and the urine was free from abnormal constituents. During the succeeding twenty-four hours the pulse-rate rose to 108, and the temperature to 101.2°. A diagnosis of acute cholecystitis was made, and operation advised.

OPERATION.—The operation was performed on Nov. 11 under general anaesthesia after a preliminary injection of morphia and atropine. The abdomen was opened by a right upper paramedian incision. The gall-bladder was obscured by a thick pad of injected omentum which was stripped easily, revealing a moderately distended and uniformly injected tense gall-bladder. The organ was removed without difficulty, there being no inflammatory adhesion to the liver, and no apparent disease of the adjacent part of the liver. The abdomen was closed, a drainage-tube being inserted down to the stump of the cystic duct through a stab puncture to the right of the incision.

The temperature fell to normal on the fifth day, and the pulse to 88. Thereafter the patient made an uninterrupted recovery, leaving the hospital in apparently perfect health on the twenty-first day. For twenty-four hours after the operation some bile escaped from the drainage-tube, but after this time there was no further discharge of any kind, and the tube was removed on the fifth day.

After removal, the gall-bladder was aspirated, and the fluid, which had a rancid odour, was submitted for bacteriological examination. The organ was then slit up, and found to contain from twenty to twenty-five pale faceted gall-stones, the largest about 1.5 cm. in diameter. Some of these also were forwarded under sterile conditions to the bacteriologist. Further investigation of the organ revealed slight uniform thickening of its wall, with uniform injection of the coats, but in addition the greater part of the mucous membrane had undergone gangrene in patches, the interior presenting the

appearance of a mosaic of green gangrenous areas surrounded by intensely congested but living mucosa (Fig. 452).

BACTERIOLOGICAL AND HISTOLOGICAL EXAMINATION.—This was carried out in the Bland-Sutton Institute of Pathology and resulted as follows:—

Fluid Contents.—The fluid was composed of thin blood-stained bile, containing a good deal of cellular debris, but only a few pus cells. It was odourless on reaching the laboratory. Gram-stained smears showed the



FIG. 452.—Gall-bladder showing gangrenous patches.

presence of large numbers of Gram-positive thick bacilli morphologically resembling *B. welchii*. Aerobic cultures in broth, on agar, and on serum agar were sterile, whilst anaerobic cultures on serum agar and in milk gave a profuse growth of an organism similar to that found in films. The culture in milk produced a typical 'stormy clot' reaction in twenty-four hours, and subcultures in various sugars gave a positive fermentation reaction in glucose, saccharose, and lactose, with no reaction in salicin. These reactions and cultural features served to identify the organism as a true *B. welchii*. The

organism had marked hæmolytic power, but no exotoxin could be demonstrated in a forty-eight hours' meat-broth culture. An intramuscular injection of bacilli into a guinea-pig produced intense gas gangrene and death within twenty-four hours.

Stones.—These proved to be composed of pure cholesterol without pigment. After repeated washings in saline several of the stones were incubated in broth, both aerobically and anaerobically. No growth was obtained in forty-eight hours in either case. The stones were then crushed and incubated again. From each of the six crushed stones *B. welchii* was obtained, and in addition, from two of them a typical *Streptococcus faecalis*.

Gall-bladder.—A section of the wall of the gall-bladder showed extensive ulceration of the mucous membrane and an acute inflammatory reaction with polymorpho-nuclear infiltration extending into the muscular layers. The mucous membrane was in many places polypoid, and showed evidence of long-standing chronic inflammation.



FIG. 454.—*B. welchii* in wall of gall-bladder.

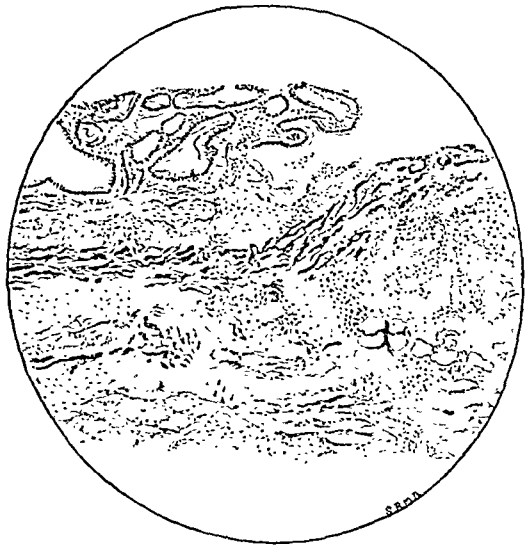


FIG. 453.—Polypoid mucosa and gas bubbles in muscular coat.

The most noticeable feature of the section was the presence of numerous clear spaces, particularly in the muscular layer (Fig. 453)—probably due to gas bubbles. Gram-stained films showed *B. welchii* to be numerous in the ulcerated mucous membrane, and also in fair numbers in the deeper muscular layers (Fig. 454).

The absence of pronounced toxic symptoms before operation, the uncomplicated convalescence, and the complete recovery in this case of *B. welchii* infection would appear to be due to a combination of favourable circumstances: first, inasmuch as the infection was confined to

the gall-bladder, the focus was capable of complete removal by operation;

secondly, the organisms in the interior of the gall-bladder were in pure culture, i.e., not associated with a virulent strain of another organism such as a streptococcus; in addition, the previous health of the patient was good, and the strain of the organism was not one productive of exotoxins.

The presence of numerous gall-stones of some size, and the polypoid condition of the mucous membrane, suggest that inflammatory disease of the gall-bladder had been present without symptoms for some little time, and it would appear probable that the *B. welchii* invaded this already damaged organ and set up a sudden acute disease, although on this assumption it is difficult to explain the presence of this organism in all the six stones cultured after crushing. Infective conditions of the gall-bladder are almost universally caused by intestinal organisms, and in view of the frequency with which the *B. welchii* is found in the intestinal flora, it is surprising that exhaustive bacteriological studies of the gall-bladder contents have failed to detect it, except on the rarest occasions. Thus in over a thousand cases studied at the Johns Hopkins Hospital and elsewhere^{1,2,3} no instance of *B. welchii* infection is reported, and the only two cases of this disease published, of which particulars are subjoined, were each looked upon as unique.

Thus in 1922 Hallé and Marquézy³ report details of a woman of 60, previously healthy, who was seized with sudden pain in the right side, with vomiting, which subsided after a few hours. Five days later, after a purge, acute symptoms occurred and she was admitted to hospital with pain in the gall-bladder area and signs suggesting pneumonia and pleural effusion at the right base. Operation was performed under a local anæsthetic; no pus was found in the peritoneum, but six to ten lesions suggesting fat necrosis were observed in the omentum, and one of these was removed for examination. The patient's grave condition did not allow of exploration of the gall-bladder. She died four days later, and at the post-mortem the gall-bladder was found to contain blood-stained fluid and gas, but no stones. It was very adherent to the liver and surrounded by omental adhesions into which perforation had occurred. *B. welchii* was recovered from the piece of omentum removed at operation, and also from the gall-bladder, liver, and spleen, inoculation into a guinea-pig proving fatal in ten hours. Histological examination revealed the presence of the organisms in the wall of the necrotic gall-bladder, in the portal vein, and in small numbers in the lobules of the liver. The case was considered to be unique, and looked upon as a primary-infection of the gall-bladder with the *B. welchii* followed by a fatal septicæmia.

In 1925 L. Kirchmayr⁴ reported a case of a man of 64 who suffered from acute abdominal pain for a short time, followed by a period of freedom of fourteen days, and then a further attack of pain, on account of which he was admitted to hospital with a diagnosis of acute appendicitis. He was slightly jaundiced, the gall-bladder was palpable and tender, the liver enlarged, and a trace of bile found in the urine. At operation a gall-bladder as big as a fist and adherent to the duodenum and lesser omentum was removed. On puncture it contained a mixture of bile, blood, and gas, and a quantity of fine sand with some small stones, the largest the size of a hemp seed. A section of the gall-bladder revealed diffuse acute gangrenous inflammation with multiple old abscesses in the thickened wall. The fluid obtained from

the gall-bladder was found to contain organisms which gave the cultural tests for *B. welchii*. The patient made a satisfactory recovery, and when last seen some months after the operation was in good health, the liver enlargement having subsided.

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FRACTURES OF THE MALAR-ZYGOMATIC COMPOUND: WITH A DESCRIPTION OF A NEW X-RAY POSITION.

By H. D. GILLIES, T. POMFRET KILNER,
AND DUDLEY STONE, LONDON.

MUCH has been written during late years about fractures of the long bones. Fractures of the bones of the face have received little or no attention. If excuses are needed for the writing of the present paper, they are to be found in the comparatively common occurrence of the fracture discussed, in the extreme scarcity of mention of it or its treatment in surgical literature, and in the fact that even well-known pathological museums do not contain a single example. Modern text-books of surgery and fractures deal with fractures of the malar-zygomatic compound so sparingly that one must be content with a few stray references or a paragraph on maxillary fractures, or be guided by a terse sentence or two covering this subject. The very considerable disability which the fracture produces, together with the unsightly deformity in facial contour, are usually not fully recognized and frequently go untreated.

Definition.—We wish to limit the present paper to a consideration of fractures met with from the auditory meatus behind to the external angular process of the frontal bone above and to the maxilla and orbit in front.

Occupying, as it does, a most prominent position amongst the bones of the face, the malar-zygomatic compound bears the brunt of resistance to violence from many directions. It is not generally realized how great a part in the protection of the eye is played by this prominence, and it is only when a number of cases of fracture of this type have been studied that it is rendered obvious to what a great extent that protection is lost, and how prone to serious injury from even such a large object as a tennis ball the eye has become.

Etiology.—Fractures in this region are always due to direct violence. They result, on the playing field, from blows with the point of the elbow or from kicks; they are produced by falls on the face; and they are especially common in motoring accidents. Our experience is contradictory to that of surgical authors who state that fractures of the malar bone are unusual.

Diagnosis.—In a typical case diagnosis may be made at sight once the characteristic appearance has been fully recognized. A peculiar facies is present, due chiefly to a certain flatness of contour and an absence of expression on the affected side. Mobility and crepitus are rare, but by careful investigation the lines of fracture may often be detected by palpation. The outstanding feature is a definite flattening of the cheek in its upper part and a fullness in its lower. This is made clearer when the area is examined from above after the traumatic effusion has subsided. Depression, as compared with the opposite side, will often amount to half an inch or more. Examination from in front, assisted by palpation, reveals abnormal irregularity in the

infra-orbital margin, above the outer canthus, and sometimes in front of the ear, where the stump of the zygomatic process of the temporal bone stands out. Palpation in the mouth reveals unnatural resistance to the finger passed along the ascending ramus of the mandible and between this and the maxilla.

At first there is much bruising and swelling, and these, as in cases of fracture of the nasal bones, mask the depression and fracture to such an extent that the underlying condition is entirely overlooked; in this way arises the necessity for late and difficult, instead of early and reasonably simple, treatment. Frequently—almost always—there is unilateral epistaxis due to damage to the mucosa of the antrum. A 'black eye' is present, together with conjunctival ecchymosis. Mastication is interfered with on account of pain produced by any attempt to use the masseter muscle, the attachments of which to the fractured and displaced bone are damaged. Mechanical obstruction to jaw movements may also be present, and is due to the pressure of indriven fragments of the zygoma on the coronoid process or the temporal muscle. Pain may be traced to damage in the region of the infra-orbital nerve, whilst from the same cause there may be numbness over the area of distribution of this nerve. The mandible usually deviates to the opposite side—a position which appears to be one of mandibular rest. Limitation of eye movements may be present where there is much interference with the floor and margin of the orbit.

Varieties of Fracture.—The malar bone represents a strong bone on fragile supports, and it is for this reason that, though the body of the bone is rarely broken, the four processes—frontal, orbital, maxillary, and zygomatic—are frequent sites of fracture. The bone is frequently separated from all its attachments and displaced *en masse*. When the anatomical position and structure of this bony element are studied, together with its susceptibility to blows from very divergent angles, it will be obvious that the lines of fracture and the displacement produced will vary in almost every case. Whilst blows at right angles to the surface produce direct depression and sometimes comminution of the body of the bone, blows from behind or from the front, from below or from above, produce sliding and tilting of the bone, and the degree of depression and displacement varies according to the direction and continuance of the force.

Four sites of fracture are found, corresponding with the points of articulation of the bone, namely: (1) Zygoma; (2) Infra-orbital foramen region—orbital process; (3) Supero-external orbital margin—frontal process; (4) Anterior wall of antrum—maxillo-malar articulation. Fracture of the infra-orbital margin occurs near its mid-point, and the inner extremity of the outer fragment may project forwards and upwards into the lower conjunctival fornix, where it can be seen and felt. The fracture line extends downwards through or near the infra-orbital foramen. Fracture in the region of articulation with the frontal bone produces an irregularity of the orbital margin in its upper and outer quadrant, whilst a similar irregularity may be palpated by the finger passed along the zygomatic arch. In cases where the swelling has already subsided these irregularities are easily seen. The mass of bone separated by these lines of fracture is usually driven into the antrum and becomes impacted there.

Complications.—Situating in a region bounded by such structures as the eye, the antrum, the nose, and the infra-orbital nerve, a fracture, with such displacement as occurs in most cases, is liable to involve some or all of these important structures. Such complications as nerve injury, eyeball injury, and involvement of the antrum or nose are quite common. In the majority of cases the anterior wall of the antrum is crushed, and a suppurating hæmatoma may result. It is essential that a careful watch be maintained for such an occurrence.



FIG. 455.—Skiagram of the normal head, not tilted, showing a supero-inferior view of the skull and the zygomatic arches.

X-ray Details (DUDLEY STONE).—Nothing is more valuable to the surgeon in determining the extent of injury and the position of the fragments—both before and after operation—than a good skiagram. To secure a satisfactory picture of the fracture a new departure in technique from methods formerly used was called for.

Supero-inferior View of the Skull.—The skiagram is taken with the tube below the couch. The patient kneels on a stool facing the couch, the elbows resting on it. An air cushion of suitable length (15 in. to 18 in.) is blown up tight, the patient leans well forward over the couch, and the cushion is placed under the chin.

Malar-zygomatic Region.—Firm supports are placed in front of the patient to the level of the top of the head. The fluorescent screen is then placed on the patient's head, and the tube box



FIG. 456.—Skiagram of a case before operation : fracture of left zygomatic arch ; supero-inferior view of left side of the skull. Head not tilted.

is pushed over as close to him as will allow of the rays just missing the chest. The diaphragm is then adjusted to cut out scattered radiation. The plate is placed in position. The patient is instructed to hold the breath, and the exposure is made as rapidly as possible. (*Figs. 455-7.*)

A symmetrical picture as a rule does not give the best view of the zygomatic arch ; the head has to be tilted slightly, usually away from the injured side, to get the arch to stand out as clearly as possible from the head.

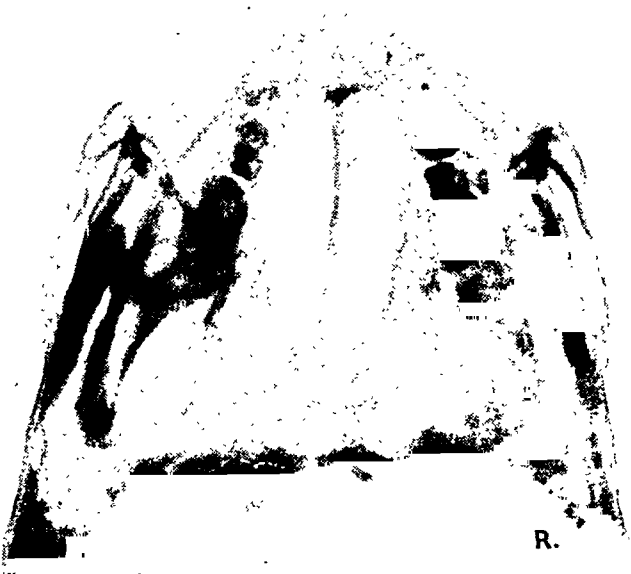


FIG. 457.—The same case as in *Fig. 456*, after operation : bones of the arch replaced. Head not tilted.

A similar technique is now employed to obtain certain views of the lower jaw, a film being gently held between the teeth of the patient. This superoinferior view has proved instrumental in demonstrating many anatomical details of the skull hitherto hidden by superimposition.

Treatment.—The methods of treating a fractured malar bone recommended by the various writers who have reported cases include simple digital manipulation under general anæsthesia, external manipulation by means of cow-horn dental forceps grasping the edges of the bone, traction and elevation by means of wire or heavy bone elevators (Bevan, Matas) passed through small local external incisions, and elevation via an incision in the mucosa of the gingival sulcus at the canine fossa (Lothrop).

Our technique, which has now been used successfully in a number of cases, differs from those mentioned. The temporal region of the scalp is shaved, and the usual skin preparation is carried out. A curved incision, $1\frac{1}{2}$ in. long, is made over the temporal muscle and well within the hair-line. The edges are retracted; a small incision is made in the temporal fascia; and a long, thin elevator is passed downwards on the surface of the temporal muscle until it lies deep to the displaced bone. When the lever is inserted in the correct fascial plane it slips under the depressed bone in a most convincing manner, while the operator's hand rests on the firm support given by the skull. The latter should be protected from local pressure injury by a large gauze pad. By careful levering movements the whole bony mass is elevated into correct position; a finger on the various points referred to previously is used as a guide to determine when this result has been achieved. (*Fig. 458.*)

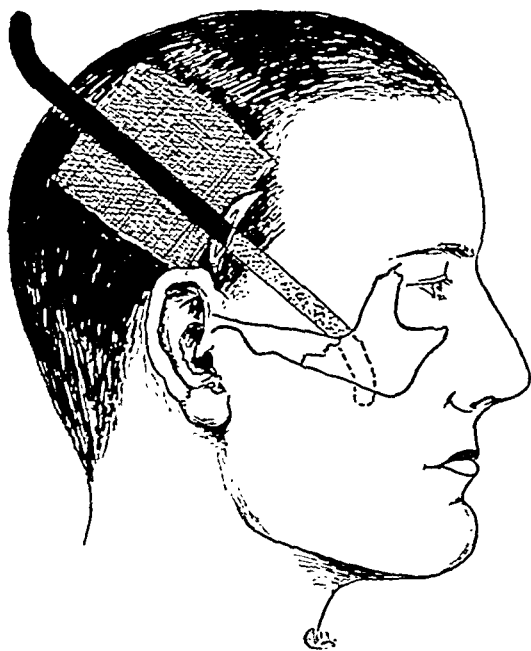


FIG. 458.—Malar-zygomatic reposition: illustration of technique.

In recent cases there is no tendency to recurrence of the displacement, for there are no serious muscular contractions to produce it. The improvement effected by the manœuvre is spectacular, and the bony mass, when thus disimpacted, is manipulated into position with ease by the combined use of the lever and the free hand. A certain amount of fixation can be obtained by a pad strapped to the face below the malar prominence.

In old neglected cases it is often necessary to cut down on individual points of fracture before the bone can be satisfactorily freed; the lines of incision required for this are frequently decided by scars already present. In most cases, however, it is possible to refracture at these points by means of a chisel or osteotome driven into the lines of fracture from the temporal incision.

Skin contraction and absorption of bone in old cases render replacement more difficult and recurrence of deformity more likely. In two of our old cases it was found necessary to wire the bone in position in the external angular process region in order to retain it in its corrected position.

Retention by intra-oral methods has proved irksome to the patient and unsatisfactory.

It is sometimes necessary to make an intrabuccal incision in order to relieve impaction in the region of the antrum. It is necessary to repeat the warning already given regarding the possibility of antral infection. Much damage may have been produced here already, and operative interference may easily lead to a lighting up of latent infection which calls for the establishment of free drainage.

The temporal incision is closed in the usual way, and no drainage is necessary.

Advantages.—The advantages of this technique are self-evident: (1) The incision is made in a region where the resultant scar is negligible. (2) The wound is far enough removed from the bruised and swollen parts for infection to be avoided. (3) The field is free from important nerves which might be injured during the operation. (4) The lines of force to be exerted in levering the bony mass into position are more easily obtained through this approach than any other.

SHORT NOTES OF RARE OR OBSCURE CASES

A CASE OF ALBERS-SCHÖNBERG'S DISEASE.

By H. R. SEAR, SYDNEY, N.S.W.

ALBERS-SCHÖNBERG'S disease (*Marmorknochen*; marble bones) is an extremely rare condition; W. G. Alexander, in 1923, could find only 9 cases, 7 occurring in Germany, 2 in America. The following case is briefly recorded, as the bones show some unusual characteristics. The typical features of this disease are the extremely dense changes in all the bones, especially the ends of the diaphyses; with marked anæmia, due probably to the diminution of the medullary spaces; enlargement of the spleen and liver; pressure on the cranial nerves, with optic atrophy, nystagmus, etc.; hydrocephalus; interference with dentition; and necrosis of the jaws. This case presented all the classical features.

J. P., male, age 6 years, was referred to the Royal Alexandra Hospital for Children, Sydney, on June 22, 1926, for treatment of his mouth and jaws, which were extremely septic. He was admitted under Dr. Edgar Stephen, with whose permission I am publishing this brief account.



FIG. 459.

HISTORY.—The family history showed no evidence of any familial disease—he was the only child of an elderly primipara. The Wassermann reaction was negative, as expected. Syphilis does not appear to be the causative factor, nor do the bone changes, as determined by X rays, suggest it. At birth the child was noticed to have a peculiar-shaped head (*Fig. 459*); at the age of 12 months his head seemed to enlarge unduly. He has always been pale. The mother thinks he had always been blind, or partially so. Mentally, he appeared alert and intelligent. Five months before admission the teeth became carious;

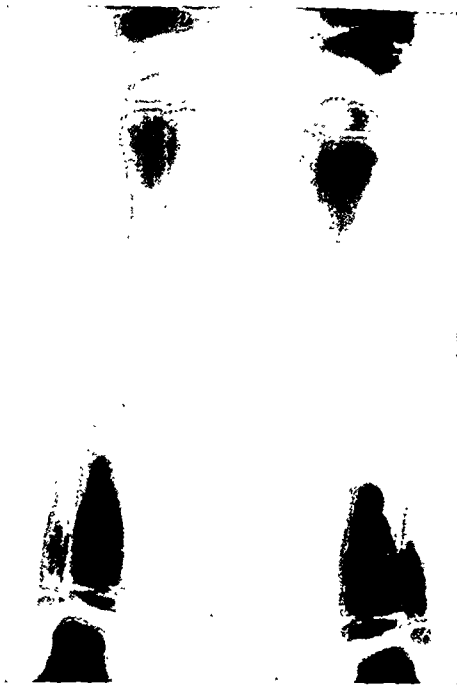


FIG. 460.—Compare with *Fig. 461*.



FIG. 461.—Enlarged from upper right-hand quarter of *Fig. 460*.



FIG. 462.



FIG. 463.—Compare with *Fig. 467*.



FIG. 464.

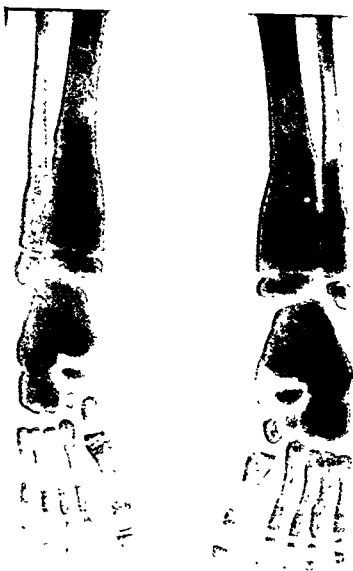


FIG. 465.



FIG. 466.

an ulcerative stomatitis developed which did not yield to the usual dental treatment, and for that condition he was referred to the Children's Hospital. A tumour appeared on the left side of the mandible two weeks after admission.

EXAMINATION.—The head was unequally enlarged, but the bony tissue had a solid uniform feel; no soft patches could be detected. The femora had a flattened feel, most marked at the lower ends. The child could walk. There was a small rounded tumour at the angle of the mandible on the left side. The liver and spleen were greatly enlarged. The child could just distinguish objects, but was unable to read. There was a bilateral divergence to the right side, and nystagmus. He appeared intelligent.

The blood-count showed a marked anæmia, with a red-cell count of 1,200,000 and a colour index of 1; there was marked anisocytosis and poikilocytosis, together with nucleated reds and a few myelocytes. The white count was 9000, with a relative increase in lymphocytes. Estimations of the calcium content of the blood were made on two occasions by Dr. Tidswell, but in neither was there any departure from normal.

The child was removed from the hospital and died outside; an autopsy was refused.



FIG. 467.—Enlarged right-hand top portion of Fig. 463.

The radiographic features of this disease are the generalized nature of the bony lesion; all bones without exception are involved; but especially the ends of the diaphyses for some distance from the epiphyseal lines; these parts assume an extremely dense structure—hence the name 'marble bones'. The cranial bones are involved, and this leads to narrowing of the foramina and hence the nerve symptoms.

The points especially worthy of note in this case (see Figs. 459–467) are: (1) Some of the bones have a curious longitudinal striation (Fig. 461), especially the radii, tibiae, and femora; usually a transverse striation has been shown radiographically. (2) The epiphyses are not uniformly dense as described before; but there is a definite more transradiant centre (see upper tibial epiphyses). (3) The shafts of the diaphyses of the metatarsals and metacarpals show a curious hour-glass central dense area (Fig. 467) surrounded by a more transradiant layer just underneath the cortex. This is quite different from the usual descriptions of the radiographic changes in these bones in this condition.

For fuller details of this disease the reader is referred to a paper written by W. G. Alexander in the *American Journal of Roentgenology* for April, 1923.

TWO CASES OF CARCINOMA OF THE COLON WITH EXTENSION TO OTHER PARTS.

By E. R. FLINT, LEEDS.

I SAW the first case, a lady, age 43, on Oct. 29, 1926. For two months before this she had had a little loss of energy and latterly some breathlessness. Apart from this she considered herself quite well, though her friends had commented upon her loss of colour. She consulted her doctor on account of the shortness of breath, when he discovered a lump in the abdomen. On Oct. 29 she was extremely anæmic, but had no other symptoms at all. There

had never been any abdominal pain, no loss of weight, no distention, no hæmorrhage, and the bowels acted regularly, the motions being of normal consistency. There was a hard lump in the region of the hepatic flexure, which I diagnosed as a growth in the upper part of the ascending colon. On Nov. 10 she was given a pint of blood by the citrate method.

OPERATION (Nov. 11).—A lump the size of a small apple was found at the hepatic flexure, firmly adherent to the second part of the duodenum. There were several enlarged glands at the lower border of the duodenum and along the course of the right colic artery, but no obvious secondary deposits anywhere. The last 6 in. of the ileum, the cæcum,

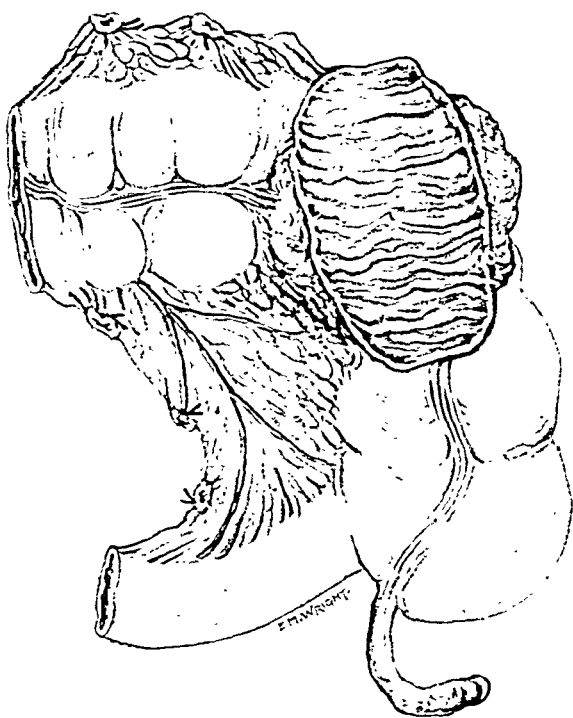


FIG. 468.—Posterior view of excised specimen: showing the resected piece of duodenum on the posterior aspect of the growth.

ascending colon, and half the transverse colon were excised together with a large piece of the anterior and lateral walls of the duodenum and the involved lymphatic area all in one piece (*Fig. 468*). The duodenum was closed and a lateral anastomosis made between the ileum and transverse colon.

The patient made an uninterrupted recovery. A microscopic section confirmed the diagnosis, and there was so much narrowing of the lumen that it would only just take one's forefinger. The unusual features of this case

were the absolute freedom from pain, the regular action of the bowels, and the normal formation of the faeces throughout.

The anæmia, which was so profound as to be easily mistaken for the pernicious type on superficial examination, is usually seen with carcinoma in this position. This is an interesting fact; carcinoma in the left half of the colon, and indeed in any other situation, with the exception of the stomach sometimes, never produces this degree of anæmia. In type it is a secondary anæmia, and I suggest as a possible explanation that something is absorbed



FIG. 469.—Posterior view of excised specimen: showing a part of the growth adherent to the pancreas. The larger part of the growth is on the anterior aspect of the specimen.

from the diseased colon, which, when it arrives in the liver, interferes with the re-synthesis of hæmoglobin; it may be that urobilin is normally absorbed from this region, and is altered in some way when disease exists here, so that it cannot take its proper part in the formation of hæmoglobin.

The second case was a man, age 43, seen on May 23, 1926. For three months he had had frequent attacks of colicky pain, becoming progressively more frequent and severe and accompanied by alternating constipation and

diarrhœa. On one occasion he had a threatening of complete obstruction. There had been much flatulence at times with distention of the abdomen: he had lost 3 stone in weight. There had been no obvious hæmorrhage, and he did not show marked anæmia. A fixed mass could just be felt under cover of the left costal margin. A diagnosis was made of growth in the splenic flexure.

OPERATION (June 1).—A large fixed lump was found at the splenic flexure as big as a tennis ball. It was adherent to the spleen and to the tail of the pancreas, but on incising the peritoneum on the outer side of the colon, it was possible to get behind the growth, and as there were few palpably enlarged glands and no secondary deposits, the whole mass was removed, taking the distal half of the transverse colon, the splenic flexure and growth, the descending colon together with the spleen and the distal third of the pancreas. A lateral anastomosis was made between the transverse colon and the sigmoid. The pancreas was crushed with a Parker's clamp and a running stitch carried round this. After slipping the clamp off, the ligature was drawn tight and the stump of the pancreas covered with omentum. Five months later the patient had put on weight and was feeling well. The bowels were acting normally and the urine was free from sugar.

At first sight this appeared to be a hopeless case, but when it was found that the growth could be raised from the posterior abdominal wall, it was thought to be worth while attempting removal, as growths in the colon are well known for their tendency to remain more or less localized for a long time.

It is not claimed, nor indeed expected, that the patient is cured, but I think his life will be prolonged and will be more comfortable, and sometimes one finds an apparently hopeless case does not develop a recurrence for a surprisingly long time. The diagnosis was confirmed microscopically, and a photograph was taken from behind which shows the spleen and pancreas (Fig. 469); the growth is on the anterior aspect of the specimen.

PYLORIC OBSTRUCTION IN AN INFANT FROM PRESSURE OF A DISTENDED GALL-BLADDER.

By H. H. GREENWOOD, SWINDON.

J. V. C., female, age 3 months, firstborn, delivered by Cæsarean section. Healthy and normal at birth—breast-fed throughout. The child was well-nourished and in good health until she and her mother went on a visit to another town two weeks before admission to Victoria Hospital, Swindon. Without any apparent cause the child began to have attacks of acute colicky abdominal pain at intervals of two days, and appeared normal between the attacks. The pain was relieved by the vomiting of partially digested milk with some greenish bile. There was no fever, diarrhœa, or passage of blood and mucus. The mother remained well, and her milk was unchanged in amount and quality.

The child was attended by two doctors, but no diagnosis was made; she was brought home and sent into hospital the next day, Dec. 8, 1926. On

the way to hospital vomiting again occurred, the amount being so large that the child's clothes were drenched.

The child was seen to be pale, with sunken features, and extremely wasted body, crying feebly at intervals and drawing up its legs, yet it was bright-eyed and free from any appearance of toxæmia. Temperature 99°; pulse 100. Soon after entering hospital the bowels were moved naturally, the first portion being green, the main portion, however, being yellow, without any abnormal odour, mucus, or blood.

The stomach was distended with gas, but at no time was a peristaltic wave seen to emerge from the left costal margin and cross towards the right side. The edge of the liver could be felt some two inches below the right costal margin. Seemingly attached loosely to the liver margin, but much more mobile, was a tense hard swelling about the size of a large walnut, close under the thinned abdominal wall. This could be moved easily (*Fig. 470*) from the margin of the liver inwards as far as the middle line, and downwards to the region of McBurney's point. Running upwards and inwards could be felt obscurely a continuation of the swelling. From the purely physical examination the swelling could only be an enlarged gall-bladder, but the symptoms

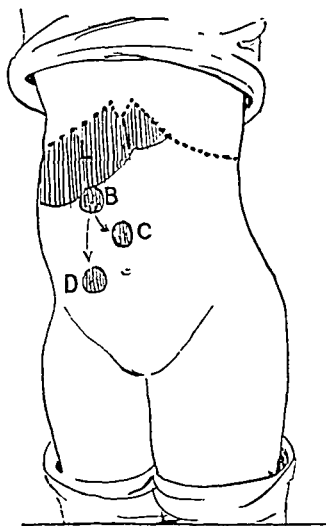


FIG. 470.—Showing extent of excursion of abdominal swelling from B to C and B to D. L is extent of liver dullness.

were more in consonance with a diagnosis of pyloric obstruction, intermittent and possibly due to a co-existing hypertrophy of the pyloric sphincter.

By restricting the diet to whey by the mouth, and saline with glucose per rectum, the vomiting was arrested, but the general condition grew steadily worse, the temperature sank below normal, and by Dec. 10 (two days after admission) the pulse had risen to 140.

With the consent of the parents an exploratory laparotomy was done, and the condition detailed below (verified at autopsy) was found:—

The gall-bladder was enormously and tightly distended, so that its outline was sinuous (*Fig. 471*), the fundus projecting beyond the liver and impinging on the anterior abdominal

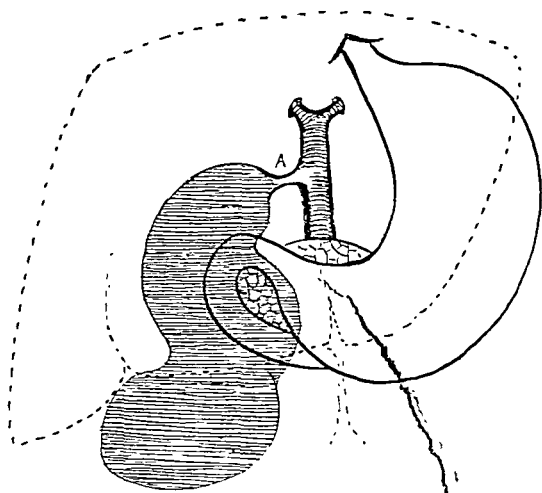


FIG. 471.—Diagrammatic figure of the parts seen at operation. A. Stenosed cystic duct.

wall; its walls were thinned, its contents a clear watery fluid, so that the organ was translucent. The antrum lay on the second part of the duodenum, compressing it against the spine. The stomach was distended by gas, and the small bowel collapsed, empty, and thin-walled, as seen in other cases of starvation. There was a small quantity of free fluid in the abdominal cavity, serous in character.

The cystic duct was represented by an impermeable fibrous cord (*Fig. 471*). The common duct was patent, and appeared unduly large in calibre. No other abnormality was found. The bladder being incontinent no specimen of urine was examined.

Death occurred soon after the patient left the operating-table, from exhaustion due to starvation caused by pressure on the duodenum by the distended gall-bladder.

It can only remain a matter for speculation as to the possibility of the child surviving a cholecystectomy or cholecystostomy done in the earlier stages of the illness. Assuredly the operation would have proved simple, and as speedy as a Rammstedt operation for pyloric stenosis.

A CASE OF PRIMARY CARCINOMA OF THE APPENDIX.

By G. B. WOODD-WALKER, London.

J. S., age 22 years, was admitted to St. Mary's Hospital on April 8, 1926, a well-nourished, active man. The history of his complaint was as follows:—

He had suffered from three separate attacks of abdominal pain. The first was in November, 1925. He stayed in bed for four days and complained of pain in the right iliac fossa. There was no vomiting, and the pain completely passed away. The second attack in January, 1926, resembled the first in detail. The third attack was in March, 1926. This was more severe and prolonged. Acute intermittent pains of a colicky nature, chiefly in the right iliac fossa, lasted a week. The pain and tenderness were still present on admission, though less severe. There was no marked tenderness on rectal examination. A diagnosis of subacute appendicitis was made, and he was submitted to operation on April 10.

The appendix was found to be longer than normal, 5 in. (normal 3·6 in., Lockwood). The distal 2 in. were swollen and distended. At the junction of the swollen and normal portions a firm nodule could be felt, the size of a pea. There were signs of recent inflammation. Appendicectomy was performed and the wound healed uneventfully. After eight months there is no evidence of recurrence.

On opening the removed appendix (*Figs. 472, 473*) the lumen was seen to be obliterated by the firm fleshy tissue. The distal end contained clear jelly-like material. No faecal concretions were found.

Dr. W. Newcomb, pathologist to St. Mary's Hospital, reported on the microscopical section of the appendix as follows:—

“A solid alveolar trabecular and tubular polygonal-celled carcinoma of the appendix is present. The growth is infiltrating the muscular coat and

also invading the mesentery of the appendix. The cells are large and contain more protoplasm than is usual in the so-called canceroid of the appendix. No mitotic figures have been seen. There is an increase in the submucous and subserous fibrous tissue, the result of previous inflammation." (Fig. 474.)

In comparing this case with recorded cases one finds much in common. Thus, in 33 cases reviewed by Rolleston and Lawrence Jones,¹ in 27 'appendicitis' was diagnosed. Raimann,² reporting 12 cases he collected from 10,651 appendices, states that they are 'almost always' accompanied by inflammation. As to sex incidence, Raimann finds that women are more commonly affected (75 per cent), but the evidence is inconclusive. In position the tumour is most frequently situated near the tip.



FIG. 472.—Drawing to show the macroscopic appearance of the removed appendix. Note position of the growth and the distended tip.

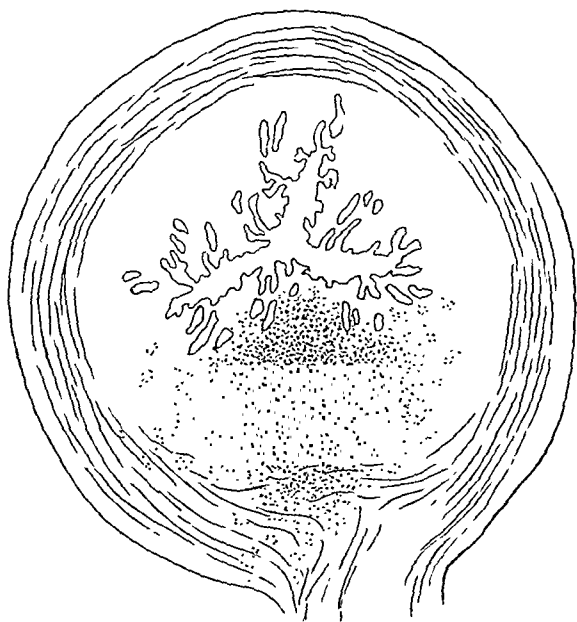


FIG. 473.—Drawing to show the position of the growth on the mesenteric side of the lumen.

Histologically, two types of carcinoma of the appendix are recognized. The commoner (82 per cent, Raimann) being the spheroidal-celled type, showing an alveolar arrangement, the less common being the cylindrical-celled, which resembles in age, incidence, and structure the cylindrical-celled carcinoma typical of the large intestine.

All are agreed that the prognosis after removal by appendicectomy is good, recurrences after the removal of the spheroidal-celled type being almost unknown. The cylindrical-celled type is considered by some authorities, perhaps wrongly, to be more malignant.

Recently the term 'basal-celled carcinoma' has been used to embrace

carcinoma and like growths clinically of low malignancy. In it are included rodent ulcer, parotid tumours, and canceroid growths of the small intestine, and these spheroidal-celled carcinomata of the appendix. The term 'basal-

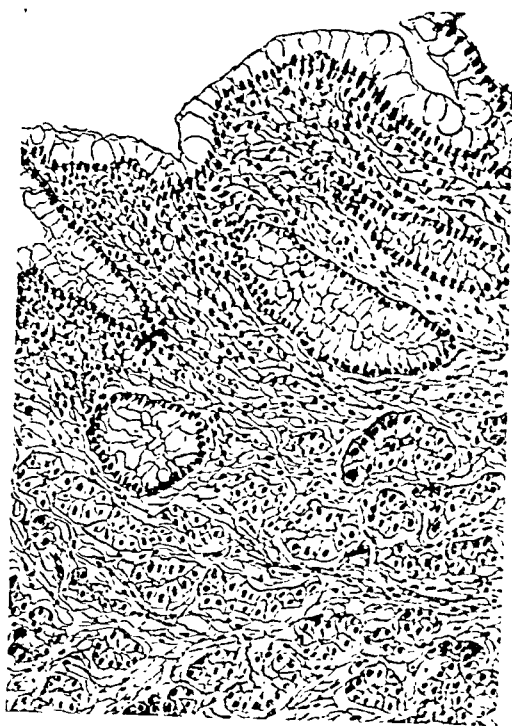


FIG. 474.—Drawing to show the microscopic appearance of the growth and the alveolar trabecular and tubular disposition of the cells.

celled' seems to have little significance, but clinically and histologically a relationship is apparent.

I am indebted to Mr. Duncan C. L. Fitzwilliams, F.R.C.S., for permission to publish this case.

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- ² RAIMANN, *Amer. Jour. Med. Sci.*, 1918, Aug.

A CASE OF HYDATID DISEASE OF THE KIDNEY.

By E. T. WILLANS, STOCKTON-ON-TEES.

WITH A PATHOLOGICAL REPORT BY M. J. STEWART, LEEDS.

THE patient, a man, age 42, came to the Out-patient Department of the Stockton and Thornaby Hospital complaining of severe pain in his left side, which had come on while he was at work. He had experienced no symptoms before.

ON EXAMINATION.—The patient was found to be extremely tender and rigid over the left hypochondriac region, so tender that it was impossible to make out anything definite. He

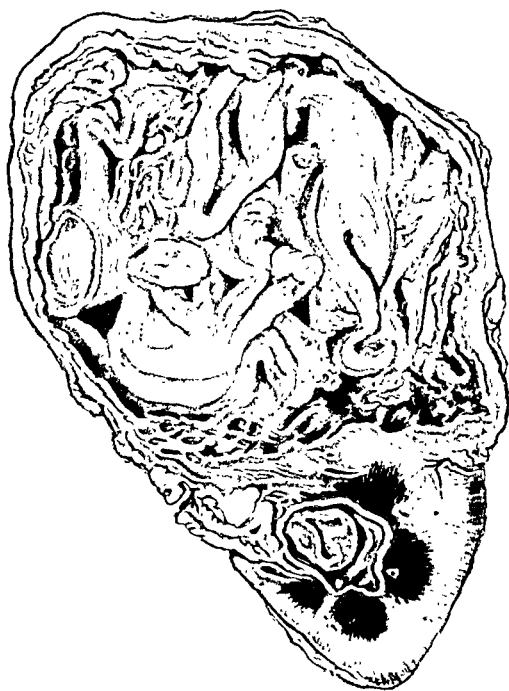


FIG. 475.—Specimen of hydatid disease of the left kidney (now in the Pathological Museum at Leeds).

was admitted to the ward, his temperature being normal and pulse-rate 78, and was kept on fluid diet; hot fomentations were applied to the tender area. The urine contained nothing abnormal. Skiagrams showed a diffuse shadow under the last rib, but no definite diagnosis could be made. After three days the extreme tenderness subsided and a large mass could be made out which suggested a kidney tumour. Six days after admission the urine was found to contain a trace of albumin, which persisted, but no trace of blood or pus was found.

OPERATION.—Usual loin incision. Large kidney tumour was found. The tumour was freed with considerable difficulty owing to the very dense adhesions. Nephrectomy was performed. While dividing the thickened ureter the clamp slipped and a stringy mucous mass of hydatid

cysts escaped from the lower end of the ureter. The wound was cleansed and closed in layers with a small tube-drain at the posterior angle.

The kidney tumour was extremely hard in parts and felt like a calcareous kidney which had become septic, and the hydatid condition was not suspected until the typical cysts escaped from the lower end of the ureter.

Professor M. J. Stewart has kindly furnished the pathological report which follows, together with the accompanying drawing (*Fig. 475*).

PATHOLOGICAL REPORT.—

Naked-eye Examination.—The shape of the kidney is generally conserved, but the upper three-fourths of the organ is enlarged and fluctuant. On longitudinal section this part of the kidney is found to be largely replaced by a hydatid cyst measuring 4 in. \times 3 in. in diameter. The wall, composed of fibrous and granulation tissue, is lined in many places by a shaggy layer of yellow necrotic and calcified material; the interior is occupied by numerous hydatid daughter cysts of various sizes. The dilated and thick-walled calyx at the otherwise healthy lower pole of the kidney also contains a daughter cyst, while others project from the cut end of the renal pelvis where it is narrowing to its isthmus.

Histological Examination.—

1. The hydatid character of the cysts is obvious from the structure of the laminated ectocyst, although neither scolices nor hooklets are present in the sections examined. Further evidence of the death of the cysts is afforded by the presence of necrotic debris, pus, and calcified material in and around the daughter cysts.

2. The wall of the main cavity is composed of an outer zone of dense fibrous tissue, a middle zone of cellular granulation tissue, and an inner lining of necrotic debris in which fragments of laminated ectocyst are readily seen. In the middle zone, in addition to fibroblasts and endothelial cells, there are great numbers of lymphocytes and plasma cells, with many eosinophil and neutrophil polymorphs. In the outer fibrous zone eosinophils strikingly predominate, with only small numbers of plasma cells and occasional lymphocytes and polymorphs. Where the granulation-tissue zone abuts on the necrotic lining layer a few foreign-body giant cells are seen.

3. The wall of the dilated calyx seen by the naked eye has its transitional epithelium still almost intact, although there is a good deal of (?) hydropic degeneration of individual cells. There is also a zone of plasma-cell infiltration of varying width immediately beneath the epithelium, with scattered lymphocytes, eosinophils, neutrophils, and endothelial cells. Outside this again there is an irregular zone of diffuse eosinophilic infiltration.

4. The renal parenchyma at the lower pole shows slight patchy fibrosis, scattered sclerotic glomeruli, and foci of lymphocytic infiltration. The tubules generally are somewhat dilated and their epithelium flattened, and the Bowman's capsules of the non-sclerosed glomeruli are much dilated and empty.

The patient made an uneventful recovery. Nothing abnormal, such as hooklets or scolices, was found in the urine, and the trace of albumin disappeared before he left hospital. No history of any attack suggesting renal colic was obtained.

ANEURYSM OF THE FEMORAL ARTERY IN A PATIENT WITH POTT'S DISEASE OF THE SPINE.*

By E. P. BROCKMAN, LONDON.

LOCALIZED tuberculous arteritis is met with in the small arteries of the brain, lungs, and other viscera. The affection of the wall of a large artery is, however, of rare occurrence. An arteritis caused by the tubercle bacillus may commence in one of two ways, either by direct extension from tuberculous tissue in its proximity, or by the carriage of the tubercle bacillus in the bloodstream. It is agreed by all the writers that the former is the method by

* From the Orthopædic Department, St. Thomas's Hospital. Read before the British Orthopædic Association, October, 1926.

which the vessels of the lungs, brain, and viscera are as a rule affected. The latter method must be of very rare occurrence.

So far as I can discover by an examination of the literature there are very few references to the involvement of the large arteries—and these are only of the aorta—by direct extension from a lesion in the neighbourhood. S. R. Haythorn¹ quotes Weigert in 1877 as stating “that tuberculous lesions of the aorta and its main branches are exceedingly rare”. He grouped them in four general types: (1) Miliary tuberculosis of the intima; (2) Polypi of tuberculous tissue attached to the intima; (3) Tuberculosis of the wall involving the several layers; (4) Aneurysms the walls of which are composed of tuberculous tissue. It is an example of the last group which I desire to record, and, so far as I can discover, there is no previous publication of a similar case.

The patient was a boy, age 14 years, who was admitted to Pyrford for treatment of tuberculous disease of the spine in August, 1924. He was fixed upon a frame and his progress was satisfactory until January, 1926, when he began to complain of a dull ache and stiffness in the right thigh. Twelve days later he complained of an acute pain in the right femoral region.

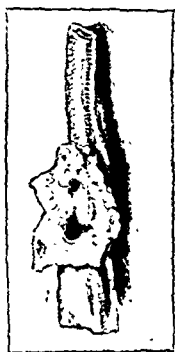


FIG. 476.
Sketch of portion
of femoral artery
excised, showing
the ruptured
aneurysm.

ON EXAMINATION.—The patient had a well-marked swelling in this area which exhibited the following characteristics: (1) It was diffuse, i.e., it had no well-defined borders or limits; (2) There was well-marked pulsation; (3) A faint thrill was present; (4) A very obvious systolic murmur, conducted up and down the femoral artery, was present; (5) Pressure on the external iliac artery caused the pulsation, thrill, and murmur to vanish, but they returned immediately on releasing the pressure.

Pulsation in the posterior tibial arteries was equal in volume in the two legs. There was no evidence of abscess in the right iliac or femoral region. Any attempts at movement of the right thigh were painful and resisted.

There was some hesitation in making a diagnosis as to the nature of this swelling, in spite of the signs which are characteristic of an aneurysm. The boy was seen by various surgeons, including Sir George Makins, and exploratory operation was decided upon.

OPERATION.—On Feb. 2, Sir Cuthbert Wallace operated. He first exposed the external iliac artery by the retroperitoneal route, and applied a temporary ligature. The swelling in the right femoral region was then explored and a large quantity of recent blood-clot evacuated from the area in relation to the outer side of the artery. It was then seen that there was a small aneurysm which had ruptured, on the anterolateral wall of the common femoral artery close to the origin of the profunda femoris. The affected portion of the artery was removed, the artery above, the superficial femoral, and the profunda femoris being ligatured. The temporary ligature around the external iliac artery was released, and the incisions were closed in the usual way. The incision in the thigh did not heal soundly, and subsequently

broke down, discharging serum and caseous material. The skin also ulcerated, and has only recently healed.

The specimen of the artery shows a small aneurysm close to the origin of the profunda femoris which has ruptured (*Fig. 476*).

Histological examination of the wall of the sac and the artery shows the tuberculous process involving all the coats of the artery, so that it is impossible to demonstrate which coat was primarily involved. There are

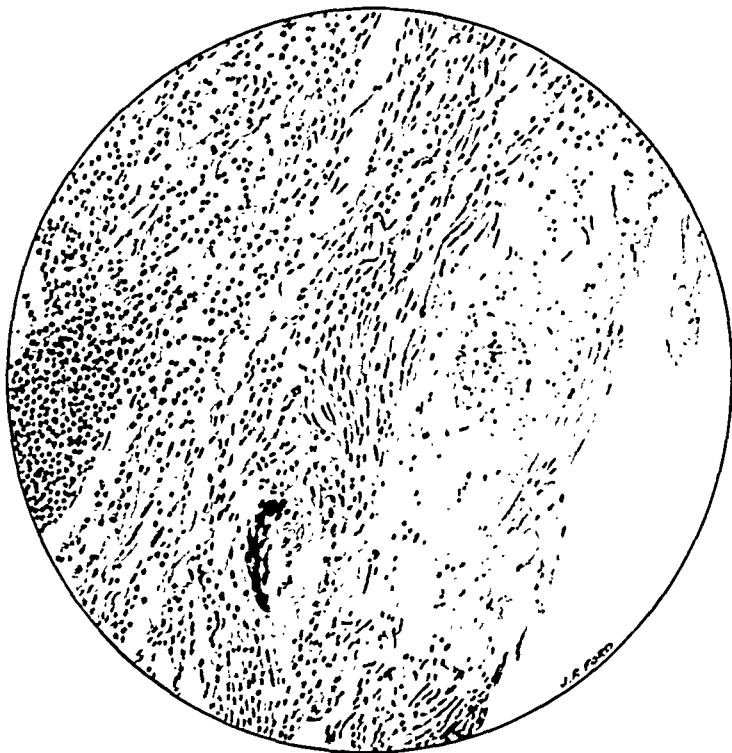


FIG. 477.—Section through the wall of the aneurysm showing typical tuberculous inflammation, giant cell, area of caseation, and small round-cell infiltration.

many large giant cells present, with endothelial cells and small round cells, also areas of caseation (*Fig. 477*). I have examined many sections for the tubercle bacillus but have not found it.

The tissues in the proximity to the artery appeared to be quite healthy, and I would suggest that the tubercle bacillus was carried in the bloodstream from some other focus, lodged in the vasa vasorum, and produced the disease of the arterial wall.

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A CASE OF LUMBAR HERNIA.

By HAROLD EDWARDS, LONDON.

ALTHOUGH the possibility of herniation occurring in the lumbar region is well known to the student of anatomy, the condition is in effect a very rare one for the surgeon to meet. The following case occurred recently in the Surgical Clinic of King's College Hospital, and I am indebted to Mr. Arthur Edmunds, under whose care the patient was, for permission to publish this record.

HISTORY.—E. G., age 19 years, first attended the Out-patient Department of the Hospital in December, 1925. He then stated that twelve months ago he felt a pain in the right loin after a hard day's work. His occupation is that of a plater's assistant, which consists of grinding and polishing nickel plates, and involves lifting and carrying heavy cast-iron boxes, which require his full strength to move. He noticed a lump in the right loin at the time he had the pain. It was not big, and disappeared after a few days. It hurt him on coughing.

Nothing further was noticed until December, 1925, when the pain recurred towards the end of a day's work. On that particular day he had not done any heavy lifting. It was on the day following the onset of the pain that he attended hospital, when a swelling was seen in the right lumbar region.

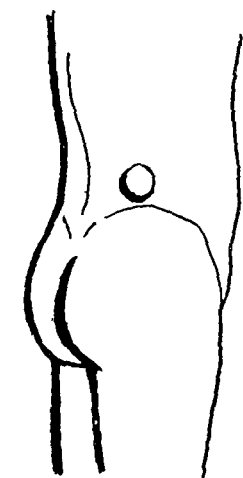


FIG. 478.—The diagram shows the site and relative size of the hernia with the patient erect.

ON ADMISSION.—The patient was admitted into a surgical ward on Jan. 20. He was a well-built, muscular boy of medium height, and had never suffered any serious illness. A well-defined swelling, 2 in. \times 1 in., presented just above the iliac crest, $2\frac{1}{2}$ in. from the posterior superior iliac spine (*Fig. 478*). The swelling was soft, not attached to the skin, and reducible on firm pressure. An impulse was felt on coughing, but it was not expansile. A diagnosis of fatty hernia was made, and operation performed.

OPERATION.—Under the anæsthetic, and with the patient recumbent, the lump had practically disappeared. A crescentic flap of skin with the base forwards was dissected up over the swelling, and the latissimus dorsi and external oblique muscles were exposed at their attachment to the iliac crest. The two attachments approximated very closely, and there was no 'Petit's triangle'.

The latissimus dorsi was partially cut through near its iliac origin and reflected. The condition represented in *Fig. 479* was now seen. The posterior border of the internal oblique muscle and the free border of the erector spinæ muscle met at an acute angle above the iliac crest. Between the two, and on a deeper plane, ran the horizontal fibres of the transversalis aponeurosis, which latter structure was rendered prominent by the subjacent swelling. The swelling thus occupied the angle formed by the internal oblique and erector spinæ muscles, which represented the lower part of the space described

by Grynfeldt and Lesshalft. The twelfth nerve crossed the space over the most prominent part of the swelling, emerging from underneath the erector spinæ muscle to pass deep to the internal oblique muscle. The aponeurosis covering the swelling was thick and granular, and was at first thought to be granulation tissue. Microscopic section of a portion removed showed, however, that it consisted of dense fibrous tissue, fatty tissue, and some striped muscle.

After retracting the twelfth nerve the aponeurosis was incised in the direction of its fibres, and on dissecting through the transversalis fascia a lobulated fatty tumour presented. This was drawn into the wound and with it a knuckle of large intestine to which the former was firmly adherent (*Fig. 480*). The large intestine withdrawn was a portion of the ascending colon.

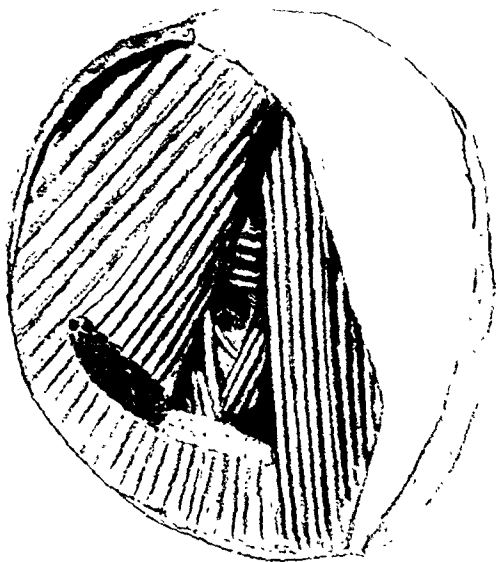


FIG. 479.—The skin-flap has been raised, and the latissimus dorsi cut through near its origin from the iliac crest, and reflected away from the posterior free edge of the external oblique muscle. It will be seen that there was no 'Petit's triangle'. The reflection of the latissimus dorsi exposes the border of the erector spinæ and internal oblique muscles as they converge to and form the apex of the upper lumbar triangle. The floor of the triangle, which is crossed by the twelfth nerve, is formed by the transversalis fascia, which in this region is pushed up into prominence by the subjacent hernia.

The hernia owned no sac—in fact, peritoneum was not exposed at any stage of the operation. The fatty tumour was dissected off the gut and removed, and the gut returned to the abdomen. The incision in the aponeurosis was sutured, and, after exsecting a portion of the twelfth nerve to avoid the possibility of its being involved in scar tissue and causing trouble in the future, the latissimus dorsi muscle was repaired and the skin incision closed.

'Grynfeldt's space', through which the hernia occurred, was first described by Grynfeldt in 1866. He called it the 'upper lumbar triangle' to distinguish it from the 'lower lumbar triangle' of Petit. The triangle is bounded above by the last rib and the lowest digitation of the serratus posticus inferior, in

front by the internal oblique muscle, and behind by the erector spinæ. It varies in shape, and may be triangular, deltoid, polyhedroid, or rhomboid. This variation in shape depends upon the size of the last rib, and the extent of the attachment to the latter of the serratus posticus inferior.

Watson collected 115 cases of lumbar hernia from the literature, including all types. Of these, 30 were through Grynfeldt's triangle and 30 through the triangle of Petit; so that from the standpoint of the occurrence of hernia the little-known 'upper lumbar triangle' is at least as important as the more

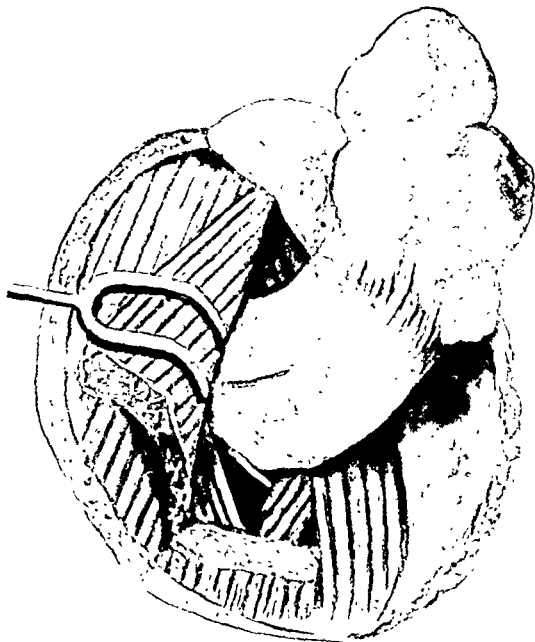


FIG. 480.—The transversalis aponeurosis and fascia have been incised and the hernia exposed. It consists of a fatty mass attached to the posterior wall of the ascending colon, a portion of which has been drawn up into the wound.

widely recognized 'lower lumbar triangle' of Petit. Furthermore, according to Goodman and Spese, Grynfeldt's triangle is more constant in occurrence than Petit's triangle (93 per cent as opposed to 63½ per cent), and has thus a definite claim to a wider recognition by both surgeons and anatomists.

The accompanying illustrations were reproduced by Mr. Edmunds from sketches made at the time of the operation.

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A CASE SHOWING ANATOMICAL AND FUNCTIONAL REPRODUCTION OF A METACARPAL BY A BONE-GRAFT.

By ANDREW FOWLER, ABERDEEN.

A FEMALE patient, A. F., age 12 years, came to me with a small swelling on the back of the left hand of about five months' duration. It was situated between the fourth and fifth metacarpal bones about half an inch from the metacarpophalangeal joint. It was hard, tender on pressure, and definitely attached to bone.

A skiagram (Fig. 481) showed a tumour growing from the radial side of



FIG. 481.—Tumour growing from radial side of fifth metacarpal bone.



FIG. 482.—Condition one month after operation.

the fifth metacarpal bone. It had the appearance of an osteochondroma, but the fan-like distribution of new bone made one suspicious of sarcoma. It was decided to remove the whole metacarpal bone with the tumour intact. Resection, including the periosteum, was done on April 7, 1924. As the prop for the fifth digit had now been removed, a graft with periosteum was cut from the tibia by an Albee motor saw. The graft was slightly rounded at the distal end and the carpus rawed with a gouge to receive the proximal end. When in position the graft fitted tightly between the carpus and the base of the proximal phalanx. Fixation of the graft was obtained by stitching the

muscles over it with No. 2 plain catgut. The hand was put up on a cocked-up plaster splint with the fingers in a semiflexed position. Passive movement was carried out on the sixth day after operation, and from then onwards the patient was encouraged to perform gentle active movements. Microscopic examination showed the tumour to be an osteochondroma.

Fig. 482, taken one month after operation, shows a suggestion of eburnation at the distal end of the graft. *Fig. 483*, taken one year after operation, shows a definite increase in size of the head evidently at the expense of the shaft, while *Fig. 484*, which was taken at two years six months, shows a well-formed head fitting into the base of the proximal phalanx; the graft is strong

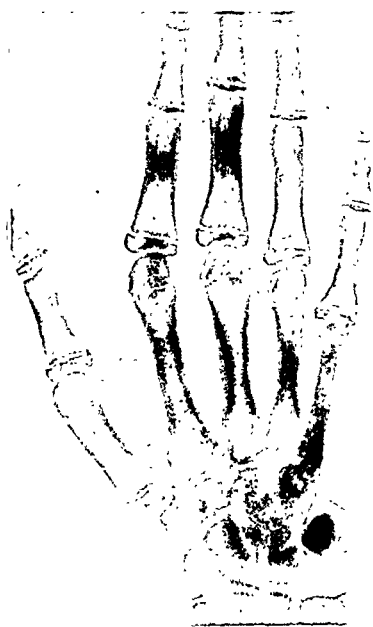


FIG. 483.—One year after operation.



FIG. 484.—Two and a half years after operation.

and has lost the ragged appearance shown in the first skiagram. The joint line is now well seen.

The function of the finger is as follows: Extension is full, flexion is three-quarters normal, and abduction full. The patient is able to play octaves on the piano. The little finger is somewhat shorter than that of the other hand, but not noticeably so.

In the treatment of this case three points are worthy of comment. First, the graft was fixed by muscle sutures only; second, the articular surface of the unciform was removed to allow of bony union with the graft; and, third, active and passive movements were commenced early.

RADIUM CARCINOMA OF THE THUMB.

By CECIL P. G. WAKELEY, LONDON.

ALTHOUGH many cases have been described of cancer due to prolonged exposure to X rays, practically none have been recorded which were the result of continued exposure to radium salts. I feel sure that cases similar to my own have occurred but have not been reported. The history of the case is as follows:—

Mr. G., age 65, had been handling radium salts continuously since 1904. About the year 1913 he noticed for the first time a little roughness of the hands, and at the same time he experienced a tingling sensation in the fingers. During the Great War (1914–18) a considerable increase in the amount of radium salts passed through his hands, with the result that in 1916 his hands became discoloured, and his nails began to fissure and become very friable. Warts first appeared on the dorsum of the hands in 1920, and gradually increased in number. In 1923 the skin of both hands was seen to be atrophic, thin, dry, and wrinkled; there were numerous small patches of lightish-brown pigmentation scattered about on the dorsum of the digits. The nails were thinned, striated,

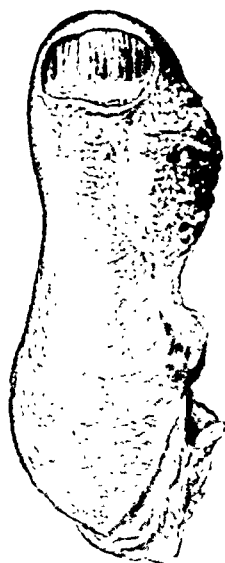


FIG. 485.—Showing carcinoma on the inner side of the thumb.

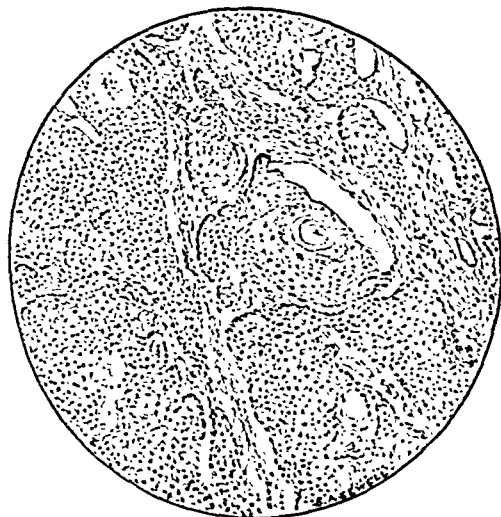


FIG. 486.—Section of growth showing typical squamous-celled carcinoma.

fissured, and brittle. The nail-bed at its free edge was markedly thickened. In September, 1923, a small wart was excised from the back of the third digit of the left hand; microscopically, this was found to consist of chronic inflammatory tissue, together with very early squamous-celled carcinoma. (Illustrations of the condition in 1923 are to be found in my Arris and Gale Lecture.¹)

The patient was advised not to touch any more radium; but he persisted in his research work, and came under observation again in May, 1924, with a large fungating

malignant growth of the right thumb. The thumb was amputated in May, 1924, and the wound healed well.

The specimen (*Fig.* 485), which is now in the Museum of the Royal College of Surgeons (No. 1871.5), shows a large raised fungating growth on the inner side of the right thumb. The nail is fissured and striated. The microscopical examination proved the condition to be a typical squamous-celled carcinoma (*Fig.* 486).

This case is of interest because it is perhaps the first case of cancer in a radium worker, and because the patient was seen off and on ever since he first noticed pigmentation in his fingers. When the carcinoma did develop, it grew very rapidly.

It is interesting to note that Mrs. G., who helped her husband in some of his radium work, and often sat and talked to him in his laboratory, died of carcinoma of the bladder. She was admitted to hospital and partial cystectomy was performed, but the growth recurred and proved fatal.

REFERENCE.

¹ WAKELEY, C. P. G., *Brit. Jour. Surg.*, 1924, xii, 137.

FOREIGN BODIES IN THE ILEAL (MECKEL'S) DIVERTICULUM, WITH FORMATION OF A PEDUNCULATED CYST WHICH STRANGULATED A LOOP OF SMALL INTESTINE.

By HUGH MILLER, EDINBURGH.

A MALE patient, age 35 years, was admitted to Edinburgh Royal Infirmary at 1 a.m. on May 7, 1926, with the following history:—

HISTORY.—He was a ship-breaker by trade and accustomed to arduous work. Since the end of 1923 he had suffered from attacks of abdominal pain and discomfort, and had experienced 'dragging pains in the stomach', especially while stooping at his work. On the afternoon before admission, when he was lifting some heavy material from the ground, he felt severe pain in the umbilical and epigastric regions of the abdomen. The pain was agonizing for a few minutes and then passed away, but similar attacks came on at intervals, becoming more severe and more frequent. He reached home in a collapsed condition one and a half hours later. Soon after, vomiting occurred, and this was repeated several times. The bowels did not move. He was seen by a doctor and removed to hospital at midnight.

ON EXAMINATION.—The patient appeared a strong, well-built man. He was obviously suffering with severe spasms of pain which passed across the abdomen, but were worst about the umbilicus. On palpating the abdomen, tenderness was found to be present in the left epigastrium, umbilical region, and right iliac fossa, and there was slight rigidity on pressure of both rectus muscles. He was vomiting bile-stained material. The pulse-rate was 80 per minute, respirations were 24 per minute, and the temperature 99°.

He stated that he was living under healthy conditions as regards housing,

work. and food. His appetite was good and he was particularly fond of sweets and fruit, especially tomatoes, oranges, grapes, and raisins, sometimes having six to ten oranges in a day.

DIAGNOSIS.—The condition was diagnosed as being acute intestinal obstruction, the cause being obscure, and immediate operation was decided upon.

OPERATION.—Cœliotomy was performed, the abdomen being opened by an incision through the right rectus sheath in its lower part. There was clear free fluid within the abdominal cavity, and distended loops of small intestine were at once seen. Then there presented a firm, lobulated cystic mass the size of a duck's egg. On trying to pull this out at the wound, it was found that the mass was attached by a pedicle $3\frac{1}{2}$ in. long. The pedicle passed down to the left side of, and then behind, a loop of small intestine and its mesentery, which were thus being strangulated. The condition found is represented in *Fig. 487*. When the loop of small intestine had been pulled up the base of the pedicle was exposed. The structure was then seen to be a diverticulum of bowel coming off the antimesenteric border of the ileum, just distal to the strangulated loop and two feet proximal to the ileocaecal valve. The loop was very congested, especially at its constricted neck, but was quite viable; the small intestine proximal to it was distended, while that on the distal side was narrow and collapsed. When the diverticulum was freed its pedicle retracted to 2 in. in length. Pressing the terminal cystic swelling could not force its contents along the diverticulum into the ileum. The diverticulum was clamped near its commencement and removed, the opening in the ileum being closed by two layers of sutures running in the transverse axis of the bowel.

The patient made an uneventful recovery, and left hospital, cured, three weeks later.

PATHOLOGY.—When removed the diverticulum had the appearance shown in *Fig. 488*. There were two distinct parts. The proximal part, or pedicle, was similar in structure to the ileum. As one passed a finger along the lumen a partition was felt stretching entirely across it at the level of a slight constriction which showed on the peritoneal surface. Beyond this was the distended mass which had first presented itself at the operation. It was smooth and red-blue in colour on the surface, and no evidence of acute inflammation was present. There was

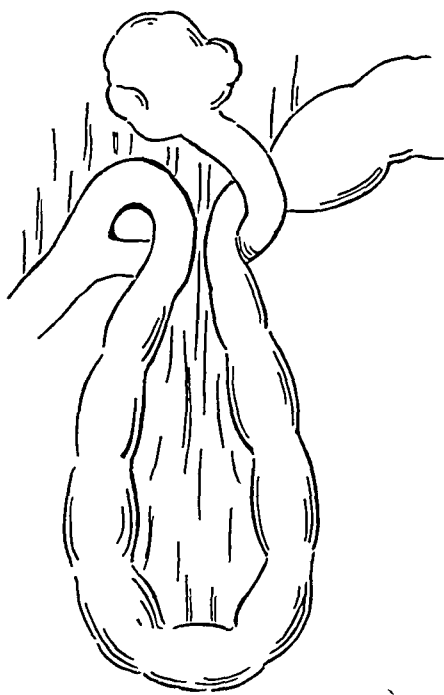


FIG. 487.—Diagram to show the way in which the loop of intestine was strangulated by the pedicle of the diverticulum.

no sign of a mesentery, or of a terminal band or adhesion between the mass and any other structure. The contents felt of fluid consistency.

The specimen was cut open longitudinally; the cystic space was found to contain clear, colourless fluid like thin mucus, and very numerous small dark-coloured foreign bodies. A sketch of the diverticulum laid open is shown in *Fig. 489*. The main cyst was irregular in shape, and communicated by a small opening with another space also packed with foreign bodies. The diaphragm closing the cyst off from the patent part had mucous membrane lining both of its surfaces. The wall of the cyst consisted of much thinned-out intestinal wall with a few small fatty collections on its peritoneal surface.

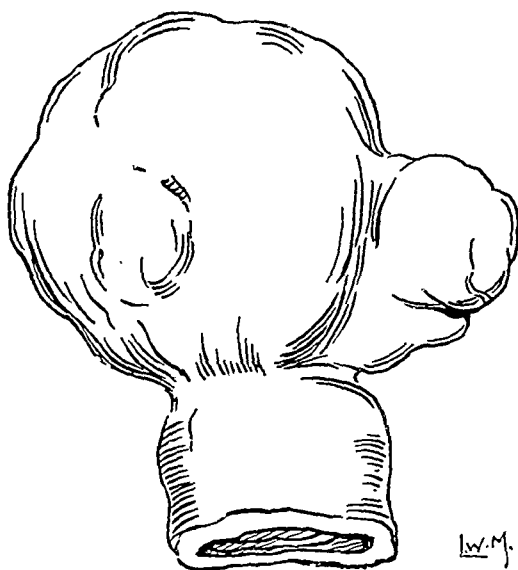


FIG. 488.—The diverticulum removed, showing its two parts.

A microscopic examination of a piece of the cyst was made by Dr. James Davidson, of the Pathology Department, University of Edinburgh, to whom I am indebted for this report :—

“The tissue examined shows mucous-secreting glands and epithelium resembling that of the small intestine, but on the whole the wall is thinner than that of the normal gut. Chronic inflammatory reaction is present. There is no pancreatic tissue or any evidence of malignancy”.

The foreign bodies were found to be seeds and other little pieces of vegetable debris—namely: 117 tomato seeds, 29 grape seeds, 10 odd shreds of husks, 1 orange pip.

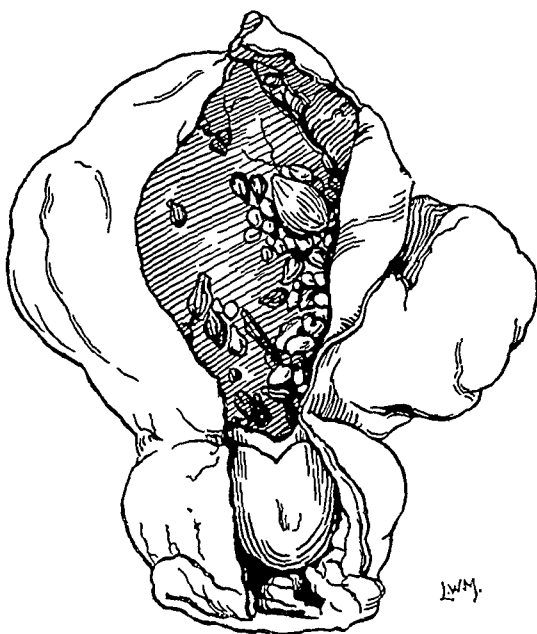


FIG. 489.—Showing the diverticulum laid open and exposing its accumulation of foreign bodies.

CONCLUSION.

From a consideration of the history and the pathological findings in this case the following appears to be the likely sequence of events. The patient from birth had a Meckel's diverticulum—a short intestinal processus from the ileum, due to non-obliteration of the foetal vitelline duct in its proximal part. This, communicating with the ileum, received intestinal contents from it. One of the folds (*plica circularis*) of mucous membrane became enlarged and formed a valve partially shutting off the distal portion of the diverticulum, and in this part seeds, etc., were held up. As the result of irritation and subsequent inflammation the free edge of the *plica* gradually attached itself to the wall of the diverticulum opposite it, until the distal portion was completely separated from the rest. This portion then became distended with secretion from the glands in the mucous membrane to the size and shape in which it was found. The weight of the distended sac caused the proximal part of the diverticulum to become stretched into the form of a pedicle, and by means of it, dragging on the ileum and mesentery resulted. This would account for the discomfort and 'dragging pains in the stomach' which the patient had complained of during the last few years. The sudden onset of his acute symptoms was produced by the pedunculated mass being swung round behind a loop of small intestine and then falling over it to the right, so as to 'snare' it, thus giving rise to acute obstruction.

The diverticulum which I have described presents some unusual features. Foreign bodies are frequently discovered in Meckel's diverticula, but this case is remarkable on account of the large number of foreign bodies (fruit seeds), and also the manner in which they were segregated. Cysts, too, are sometimes present in connection with Meckel's diverticula. These are considered to be *embryonic* in origin, being derived from rudimentary portions of the vitelline duct; but the cyst in my case was an *acquired* one, produced by the terminal part of the diverticulum becoming shut off during life. I do not think such a variety has been previously described. The way in which strangulation of the bowel occurred is also of interest. A common factor in causing this is a remnant of the vitelline duct forming a fibrous band between the distal end of the diverticulum and the abdominal wall. No such band was present, however, and the strangulation was brought about by the peculiar nature of the diverticulum itself, in the manner shown.

I wish to express my indebtedness to Mr. George Chiene, F.R.C.S., in whose wards the patient was treated, for helpful advice in writing this case, and for permission to publish the notes.

REVIEWS AND NOTICES OF BOOKS.

Manual of Surgery. By the late ALEXIS THOMSON, M.D., F.R.C.S. (Ed. and Eng.), Professor of Surgery, University of Edinburgh, and ALEXANDER MILES, M.D., LL.D., F.R.C.S. (Ed.), Consulting Surgeon, Royal Infirmary, Edinburgh. Seventh edition. Vol. III, Thorax and Abdomen. Crown 8vo. Pp. 567, with 169 illustrations. 1926. London: Oxford University Press. 12s. 6d.

THE fact that this well-known text-book is no longer small or short is shown by the size of the present volume, which deals only with the thorax and abdomen. It is, of course, filled with sound fact and excellent illustration from the first page to the last. Probably the authors, if they had foreseen the size to which their work would grow, would have used a larger page, and it is certainly a drawback that so many of the reading pages are cut up by the figures. The profuse clinical illustrations alone make the book worth getting, but when considered in relation to the needs of the text, we find that they deal too much with unusual conditions—for example, hypertrophy of the breasts or diverticula of the small intestines—and too little with matters of everyday importance—the X-ray appearance of gastric ulcer or growth, for instance.

There are a few important points in diagnosis and treatment which we think might have been included. The radiographic findings in gastric and duodenal ulcers are described very inadequately. In the case of gastric ulcer the characteristic spasm opposite to the crater is not mentioned, nor is the deformity of the duodenal cap in duodenal ulceration. In the treatment of acute peritonitis and appendicitis the possibility of treating ileus by a short-circuiting operation is not mentioned. In the sections on renal and prostatic disease the most simple and useful test of renal efficiency, namely, the urea-concentration test, is omitted.

A Shorter Surgery: A Practical Manual for Senior Students. By R. J. McNEILL LOVE, M.B., M.S. (Lond.), F.R.C.S. (Eng.), First Surgical Assistant, London Hospital. Demy 8vo. Pp. 298 + viii, with 43 illustrations and 13 plates. 1926. London: H. K. Lewis & Co. Ltd. 12s. 6d. net.

It is difficult to understand what are the scope and object of this book. In the preface it claims to be a sort of companion to the larger text-books, but it is not evident whether it is intended to be used as an introduction or as a 'refresher'. That there is a great deal of sound information clearly imparted almost goes without saying, as the book is written by an active teacher of the London Hospital; but it is so unequal in its dealing with surgical problems that it cannot be a guide for the ordinary student. For example, the routine treatment of fractures is not mentioned, although such conditions as the so-called diseases named after Köhler, Schlatter, Osgood, and Madelung are shortly described. The operation for meningeal hæmorrhage is described in detail, but there is no account of the general method of examining the abdomen in acute conditions. Similarly in the illustrations a good photograph of a hand in syringomyelia is given, but there is no picture of any of the common deformities.

Surgical Applied Anatomy. By the late Sir FREDERICK TREVES, Bart., revised by C. C. CHOYCE, C.M.G., C.B.E., etc., Professor of Surgery, University of London, etc. Eighth Edition. Fcap 8vo. Pp. 727 + x, with 162 illustrations, including 66 in colour. 1926. London: Cassell & Co. Ltd. 14s. net.

ONE turns over the pages of so old a friend in a spirit of pleasant recollection and apprehensive doubt, delighted to be able to recall some paragraph or figure which has been useful, yet fearful that one may no longer find one of those delightful narratives—one had almost said fairy tales—which are often the best remembered features of this kind of book. In this edition we miss some treasures of our youth, but much has been added in an endeavour to bring the volume up to modern practice and thought. It has owed a great deal to the wide scientific knowledge of its former editor, Sir Arthur Keith; in his hands its anatomy was made accurate, and much of value in the field of comparative anatomy was included. Its new editor is to be congratulated on being privileged to follow two such gifted predecessors; this edition bears evidence that he has begun his work extremely well.

The centres around which surgical thought revolves have greatly changed since Treves wrote this book in 1883, and revision must be along the lines of modern surgery, difficult though it must prove to be. There are many quotations of little value by authors who, even to the present writer, are only a name, and who to the modern student must be quite unknown. These should give room for larger chapters on the anatomy of the chest and sympathetic nerve system which recent surgical advance has rendered necessary.

The diagrams are on the whole well designed, but several of the cross-sections scarcely justify in value the space they occupy.

La Pratique chirurgicale illustrée. By VICTOR PAUCHET. Fasc. X. Royal 8vo. Pp. 250, with 235 illustrations by S. DUPRET. 1927. Paris: Gaston Doin et Cie. 7s. 6d.

IN this volume Victor Pauchet describes an ingenious operation for enucleation of a lingual goitre. He employs local anaesthesia and a preliminary tracheotomy. A longitudinal incision just above and parallel to the hyoid bone is used, and the prelingual muscles are divided. A short left lateral vertical incision is then made, the inferior constrictor divided, and the pharynx opened. Through this opening the pharynx is rendered anaesthetic with gauze soaked in cocaine solution. The goitre is then aspirated through the mid-point of the first incision, and the hyoid muscles are divided until the goitre is reached; this is enucleated with the finger after the method of prostatectomy. A note of warning is sounded of the possible absence of both thyroid and parathyroids in the neck and the risk of myxoedema and tetany.

The indications for cholecystostomy and cholecystectomy are fully discussed, and in a summary Pauchet states that after having performed a great many cholecystectomies even in acute cases he has now 'sobered down' and performs cholecystostomy more often than he used to do.

In dealing with various forms of gastro-enterostomy, anastomosis with Jaboulay's button without any accessory sutures is fully described. Its use is recommended in some cases of inoperable carcinoma, and as a preliminary to partial gastrectomy. Amongst other indications for the use of the button Pauchet considers that the anastomotic opening is less liable to invasion with growth and that the operation involves a minimum of surgical manipulation in cases complicated by adhesions. The indications for partial gastrectomy in two stages are dealt with thoroughly and are most beautifully illustrated. Total gastrectomy is advocated only when circumstances render it alike unavoidable and at the same time reasonably possible.

The method of introducing radium needles into a rectal growth after exposure from behind which Dr. Neumann, of Brussels, originated and has described as the barrage method is most clearly illustrated.

The articles on the operative treatment of hydatids of the liver and abscess of

the liver by Drs. Pierre Mornand and Le Roy Des Barres respectively follow more or less conventional lines. Both are good and vividly portrayed.

Professor Léon Bérard contributes a very interesting article on resection of one phrenic nerve to produce hemiparalysis of the diaphragm and pulmonary collapse in the treatment of tuberculosis of the lung. He also employs the operation as a supplement to artificial pneumothorax when this has proved inadequate, and as a preliminary to certain plastic operations on the thorax. Professor Bérard has performed this operation fifty-eight times, and there have been no gastric or cardiovascular complications.

The volume concludes with a good description of the operative treatment of injuries to the semilunar cartilages by Professor Tavernier, who, in operating on the internal cartilages, employs a long transverse incision and deliberately divides the internal lateral ligament to secure complete exposure of the whole meniscus.

The high standard of cinematographic illustrations which M. Dupret has established in previous volumes is well maintained throughout.

Die Chirurgie: A System of Surgery. Edited by Professor KIRSCHNER (Königsberg) and Professor O. NORDMANN (Berlin). To be completed in six volumes. Fasc. 12, Part 2 of Vol. IV. Imperial 8vo. Pp. 274, illustrated. 1926. Berlin: Urban & Schwarzenberg. M. 20.

THIS is a paper-covered volume, being a small part only of a large text-book of surgery which is appearing in instalments. The contents of this number include: "The Surgery of the Oesophagus", by Professor Schmerz, of Grez, and "The Surgery of the Mediastinum", by Professor Wendel, of Magdeburg. Perhaps the most striking feature is the section in which the various methods that have been devised for making an artificial oesophagus have been gathered together and described. Otherwise the book is written on the conventional lines of most text-books.

Lehrbuch der speziellen Chirurgie, für Studierende und Aerzte. Edited by Professor HOCHENEGG (Vienna) and Professor PAYR (Leipzig), with the collaboration of twenty-four other surgical specialists. Second edition. Volume I in two parts. Pp. 1244, with 527 illustrations. 1927. Berlin and Vienna: Urban & Schwarzenberg. M. 36.

THE first volume of this large text-book deals with the head and neck; chest and breast; and the vertebral column and pelvis. The section on the skull and its contents by Payr and Sonntag is in many respects one of the best in the volume, particularly in regard to the many excellent coloured figures and diagrams illustrating the circulation in the skull and brain and the description of the pathology of general head injuries. There is also a good account of various methods of opening the skull and of cranial plastic surgery. The description of plastic face surgery and that on cleft-palate are very inadequate. The sections on special subjects, e.g., the nose and teeth and ear, do not seem to us to be as complete as one would expect in a work of this size and character.

The section on the mouth and tongue (Hochenegg and Harmer) is, like so much of this book, curiously unequal in its description of rare and common diseases. Thus the uncommon affections, e.g., macroglossia, angioma, and papilloma of the tongue, are described and illustrated fully, whereas epithelioma of the tongue is dealt with in two pages without a single illustration. The section on diseases of the jaws (Gnezda) gives a good account of the new growths and inflammatory conditions and of the various operative procedures for excision of the upper or lower jaw, but the account of bone-grafting for defects of the mandible is much too brief to be of any practical value.

The section on the thyroid gland (Payr and Ladwig) is complete and well illustrated, especially in regard to the X-ray appearances of the trachea in the different

forms of goitre. Diseases of the œsophagus are described by Heynowsky, and there is a good account of the various forms of stenosis and dilatation of the gullet with the X-ray appearance of each. The section on thoracic surgery (Kleinschmitt) is full and complete in regard to the inflammatory affections of the pleura and their treatment, but the important subject of mediastinal tumours receives very short notice. The concluding section of this volume are chiefly notable for the excellent articles on scoliosis (Lorenz and Hass) and on spinal tuberculosis (Hass).

Operative Frakturenbehandlung. By Dr. RUDOLF DEMEL, Assistant in the Surgical Clinic of Vienna. Medium 8vo. Pp. 227 + viii, illustrated. 1926. Vienna: Julius Springer. Bound, 31s. 6d.; unbound, 28s.

DURING the year 1924 and the first half of 1925, 1400 fractures were treated in v. Eiselsberg's clinic; of these 77 were dealt with by open operation, and this material is the basis of the work in question. Of the methods employed the most common was fixation by wire, to which the use of Lambotte's bands was the most favoured alternative, while Lane's plates were used only in two cases. In more than a quarter of the cases reposition by open operation without any internal splint was employed.

For wiring fractures special instruments have been introduced, and a large proportion of the book deals with the technique and the results of wiring after the method of the clinic. This follows the old-established plan of encircling the bone with one or more loops of wire: this is obviously limited in its use to oblique fractures of the long bones and to such fractures as those of the patella and lower jaw; at the best no more than partial immobilization is obtained.

The radiograms, which are poorly reproduced, suggest that not a high level of anatomical accuracy is obtained by the methods employed, but some figures show good functional results. The different operations which have been introduced for the treatment of fractures are briefly reviewed in the comprehensive manner which one would expect of an author working under Eiselsberg, and a most complete bibliography is included.

Etudes sur les Affections de la Colonne vertébrale. By ANDRÉ LÉRI, Faculty of Medicine of Paris. Preface by PIERRE MARIE. Medium 8vo. Pp. 526, with 115 illustrations. 1926. Paris: Masson et Cie. 7s. 6d.

THIS is in no sense of the word a text-book. It consists of a series of articles, well illustrated by descriptions of actual cases, diagrams, and X-ray photographs. The style is delightful, interesting, and fluent, but free from that apparent inconsequence so often found in French scientific works which strikes the English reader as almost frivolous. As with most French writers, the author's powers of clinical observation and description are beyond praise, and the material at his disposal must have been colossal.

The book is divided into sections on congenital and acquired disabilities. Of congenital disabilities Professor Léri takes first those caused by spina bifida occulta, and makes out a strong case for ascribing to this defect certain trophœdemata, sclerodermata, late paralyses, and, last but not least, certain cases of enuresis. In this last section he strikes new ground in claiming that a number of cases of enuresis resistant to ordinary medical therapy have been proved to be due to an obstructing band in the neighbourhood of a spina bifida occulta, and have been instantly cured by the removal of the same.

Next he considers the possible effects of errors of differentiation in the different sections of the spine. Our favourite section of the book is that devoted to sacralization of the 5th lumbar vertebra and lumbalization of the 1st sacral vertebra. These have hitherto received more study in America than in Europe, and we welcome Professor Léri's views as recognizing the importance of these deformities, while striking a very much more just balance than most American authors in ascribing

the production of symptoms thereto. Especially are we pleased to note that he puts quite as much blame on the erratic 1st sacral as on the erratic 5th lumbar.

The section on cervical rib is an excellent morphological study, but is less important from a therapeutic point of view. Spondylose rhizomélique receives careful study, as befits a French observer, and the conclusions drawn from observations seem sound. It is a rare disease, and the dual causes of infection and compensatory fixation are well put forward. Crush fractures of the vertebrae are said to be quite common, and with this observation we entirely agree. The results of burial by shell-bursts in the late war have shown us how slight may be the immediate effects of such fractures, and these observations have led to more frequent skiagrams of the spine in cases of obscure backache, and the discovery that crush fractures may easily be produced by quite moderate violence. The concluding section on localized rheumatic affections of the spine is a convincing and profound attempt to reduce to order the rather vague conceptions too frequently held on this subject.

We can confidently recommend Professor Léri's book to the attention of all orthopaedic surgeons, and shall hasten to investigate these affections in the light of his observations. He promises us a companion volume on diseases of the bones and joints (excluding the spine), to the appearance of which we look forward with pleasure, and shall expect to find therein as great a stimulus as in the present volume.

Infections of the Hand. By LIONEL R. FIFIELD, F.R.C.S. (Eng.), Surgical Registrar and First Assistant and Demonstrator of Anatomy, London Hospital, etc. Crown 8vo. Pp. 192 + viii. with 67 illustrations, including 2 coloured plates. 1926. London: H. K. Lewis & Co. Ltd. 9s. net.

WE cordially welcome this book because it gives a good account of important work, e.g., that of Kanavel, which hitherto has been difficult of access to English readers. The great wealth of diagrams and drawings makes the chief anatomical points and their surgical bearing quite clear, but we do not find all the descriptive matter in the text easy to follow, and we fear it might be confusing to those who had forgotten their ordinary anatomy. We also regret that the description of small artificial spaces like that called Perona's space is included, because this introduces unnecessary complexity into the subject. However, these are but small matters, and the main lines of tendon-sheath, fascial-space, or lymphatic infection are well described, and their treatment is placed on sound lines.

Surgery of the Colon. By F. W. RANKIN, A.M., M.D., F.A.C.S., Visiting Surgeon to St. Joseph's and Good Samaritan Hospitals. Surgical Monographs under the supervision of DEAN LEWIS, A.B., M.D., EUGENE H. POOL, A.B., M.D., and A. W. ELTING, A.B., M.D. Imperial 8vo. Pp. 366 + xiv, illustrated. 1926. New York and London: D. Appleton & Co. 21s. net.

THIS book, as the author says in his preface, makes no attempt to express any arbitrary opinion of his own, but is a compilation and comparison of the sentiments of surgeons of wide experience. The literature has been reviewed thoroughly with the idea of correlating the views of various authorities in dealing with surgical conditions of the large bowel, excluding the rectum, and more especially malignant disease. There are eighteen chapters; the first is devoted to anatomy, and each of the following deals at some length with one of the seventeen lesions to which the colon is liable; at the end of every chapter is a comprehensive bibliography.

We think all the sections are excellent, and if we were to give particular notice to any one, it would be to that devoted to carcinoma of the colon. The author has evidently laid himself out to deal more exhaustively with this subject than with any other, and this is as it should be, for carcinoma is the most important surgical disease of the colon, and the differences of opinion with regard to treatment are perhaps more noticeable in the literature of this disease than in any other. As the author points out, the right and left colon are so different in anatomy and function

that they cannot be considered together for purposes of treatment. Opinion seems to be generally tending towards removing growths in the former, in the absence of acute obstruction, in one stage, and in the latter in two stages. He quotes mortality statistics from many eminent sources in substantiation of his views. Though the appropriate treatment is indicated in each chapter, it is only in the one on carcinoma that technical details are entered into at all fully, and here considerable prominence is given to the various methods of aseptic resection.

The last chapter is a short one dealing with intestinal stasis. No definite line of treatment is indicated, though the author leans towards a conservative policy, and this, in our opinion, is the proper position in which to leave the subject at the present time, for it cannot be said that there is any unanimity in this respect when authoritative opinions are so far apart as to regard this disease on the one hand as never requiring surgical treatment and, on the other, as needing removal of the entire colon.

In some regions of the body surgical principles and technique have reached a stage of excellence from the point of view of both morbidity and mortality results beyond which expectation of improvement is hardly reasonable; this cannot be said of the colon, and in these circumstances a comprehensive review of authoritative opinion from time to time is desirable and necessary. This book fulfils these considerations excellently, and we strongly recommend it from this point of view.

Etudes sur la Tubage Duodénale—l'Epreuve de Meltzer-Lyon. L'Alimentation duodénale. By Dr. R. DAMADE (Bordeaux). Royal 8vo. Pp. 91, with 7 illustrations 1926. Paris: Gaston Doin et Cie. Fr. 15.

THIS is a small brochure of ninety-one pages which deals with: (1) The test of Meltzer-Lyon; (2) Duodenal feeding. The method of carrying out the Meltzer-Lyon test, its physiology, and its application to diagnosis and treatment occupy the first part. The second portion gives a full account of the technique of Einhorn's method of duodenal feeding, together with the indications and results. Thus, in a very short space will be found a most reasonable and sane account of a method of diagnosis and of treatment which certainly appears to have a place in the study of gastroduodenal disorders.

Die Klinik der bösartigen Geschwülste. Edited by PAUL ZWEIFEL and ERWIN PAYR (Leipzig). Vol. III. Pp. 656 + xvi, with 184 illustrations in the text, and 44 coloured plates. 1927. Leipzig: S. Hirzel. Unbound, M. 76; bound, M. 85.

THIS is the third volume of a large work on malignant tumours in all parts of the human body. This particular volume deals mainly with malignant tumours of the female generative apparatus, including the breast. It is a large, cumbersome publication, but well illustrated with many coloured drawings. It is intended for the use of practitioners in order to give them the latest ideas on technique and treatment of malignant disease. Of its kind it is quite good, and the indications for the alternative treatment of X rays and radium are discussed with some care.

Diseases of the Nose and Throat, comprising Affections of the Trachea and Oesophagus. A Textbook for Students and Practitioners. By Sir ST. CLAIR THOMSON, M.D., F.R.C.P. (Lond.), F.R.C.S. (Eng.). Third edition. Medium 8vo. Pp. 943 + xvi, with 379 illustrations in the text, 12 black and white, and 12 coloured plates. 1926. London. Cassell & Co. Ltd. 45s. net.

THE appearance of a third edition of this work is very welcome. The first edition was published in 1911 and it then obtained universal approval. The rapid advance in this speciality has necessitated a somewhat extensive increase in the size of the

present volume. The fact, however, that the changes made are in the direction of addition, rather than alteration, speaks for itself. The first edition could be regarded as a standard by which other text-books should be judged. It was both complete and concise, and it showed a breadth of outlook unfortunately somewhat rarely met with in the specialist. Both letterpress and illustrations were excellently produced, and printer's errors were conspicuous by their absence. As far as the new edition is concerned, it need only be said that the former high standard has been maintained or enhanced. Amidst an enormous mass of new material, the choice of what to include and what to omit has been made with very sound judgement. The amount of new work entailed in the preparation of this edition must have been very great, and the profession owe a debt of gratitude to Sir StClair Thomson in that he has given to them so generously of his ripe experience.

Cavernous Sinus Thrombophlebitis and Allied Septic and Traumatic Lesions of the Basal Venous Sinuses. By WELLS P. EAGLETON, M.D., Newark, N.J. Post 8vo. Pp. 195 + xxiii, illustrated. 1926. New York: The Macmillan Company of Canada Ltd. \$4.50.

THIS study is based on the author's experience of a series of twenty-five cases, which, in dealing with a somewhat rare condition, must be accounted a considerable number. These cases are reported in great detail. The material is classified in accordance with the route by which infection has reached the sinus. The importance of early diagnosis, without waiting for the development of such classical signs as exophthalmos, etc., is emphasized, if the results of operation are to be better in the future than they have been in the past. In regard to operation, the somewhat surprising suggestion is made that it may be advisable to ligate the common carotid, so that the cessation of pulsation may give rest to the inflamed sinus. The work embodies a considerable amount of research, has an extensive bibliography, and obviously embodies the result of much thought. The superabundance of detail does, perhaps, tend to obscure to some extent the broad principles involved.

Bernhard Heine's Versuche über Knochenregeneration, sein Leben und seine Zeit. By Dr. K. VOGELER (Berlin), Dr. E. REDENZ, Dr. H. WALTER (Würzburg), and Professor Dr. B. MARTIN (Berlin), with a Preface by Professor H. BIER. Medium 8vo. Pp. 224, with 105 illustrations in the text and one portrait. Published by the German Surgical Society. 1926. Berlin: Julius Springer. Reichsmarks 7.50.

BERNHARD HEINE, who was born in 1800 and died in 1846, worked chiefly at the University of Würzburg, and has left to that institution a remarkable collection of instruments and specimens chiefly dealing with the growth and regeneration of bone. In the first place there is a comparatively complicated mechanically-driven saw or osteotome by means of which Heine cut the bone in his experiments. Then there are about one hundred specimens from the skull and limb bones of dogs showing the results which followed removal of parts of the bone, the periosteum, and the marrow. The conclusions which Heine reached were very similar to those of Ollier, and pointed to the periosteum as being the main factor in osteogenesis. The careful details in every experiment and the preservation of these specimens of one hundred years ago make this monograph one of great interest and importance.

Travaux de la Clinique chirurgicale de la Salpêtrière. By A. GOSSET, Professeur de Clinique chirurgicale à la Faculté de Médecine de Paris; *Chirurgien de la Salpêtrière*. Vol. I. First series. Imperial 8vo. Pp. 254, with 118 illustrations. 1926. Paris: Masson et Cie. 8s. 4d.

THIS is a new work, and one which is well worth perusal. It is compiled by Monsieur Gosset, who is Professor of Clinical Surgery in the Faculty of Medicine in Paris and Surgeon to the Salpêtrière, in collaboration with fourteen others who hold important positions in the medical world of Paris.

One may describe the volume as the collected papers of Gosset and his co-workers and a reflection of their activities. The articles, which number sixteen, include "Choledochotomy for Lithiasis" (A. Gosset), "Cholecystography" (Gosset and Loewy), "Formation of White Bile" (Gosset and Bertrand), "Gliomatosis of the Stomach" (Gosset and Bertrand), "Pyloroplasty by the Flap Method" (Marcel Thalheimer), and others interesting both to surgeons and clinicians. There is also a very interesting paper on "Tumours of Plants" by J. Magrou, in which the recent developments of the *Bacterium tumefaciens* are discussed. It may seem strange to find such a paper in a surgical journal, but it appears to illustrate the wide outlook of Professor Gosset, who, in 1923, annexed to his surgical clinic in the Salpêtrière a laboratory of vegetable biology. It is certain that the study of the tumours of plants is of great interest in comparative pathology and may perhaps throw light on the problem of human tumours.

The whole volume is well printed and illustrated, and is a worthy addition to surgical literature.

Principles and Practice of Oral Surgery. By S. L. SILVERMAN, D.D.S., F.A.C.D., Clinical Professor of Oral Surgery, Atlanta-Southern Dental College, etc. Medium 8vo. Pp. 326 + xvi, with 280 illustrations. 1926. London: Henry Kimpton. 25s. net.

In England it is the usual practice for the minor surgical operations in the mouth to be carried out by dental surgeons and the major operations by general surgeons. In America during recent years the trend has been to promote the surgery of the mouth and associated parts to a specialty, and certain of the medical colleges have founded chairs of oral surgery, these positions in some cases being held by men possessing the dental qualification only. The result of the elevation of oral surgery to a specialty has been the appearance of books devoted to this branch of surgery, and of these that by Dr. Blair is perhaps the best known in this country.

Dr. Silverman's book, which is the latest addition to this group of works, runs into just over three hundred pages and is lavishly illustrated. The treatment of the different subjects is unequal—for example, nearly one quarter of the book is devoted to cleft lip and cleft palate, while the important operations of removal of the maxilla, the mandible, and the tongue are dealt with in twenty pages. The chapters on cleft lip and palate are the best in the book, the technique of the various operations being described in clear terms. The author would appear to be an advocate of Brophy's operation, which has not found much favour in this country, and he gives answers to the usual objections urged against this operation. The chapters dealing with alveolectomy, apico-ectomy (amputation of the apex of a tooth root), and misplaced teeth contain useful information, and the operations are described in detail. It is the chapters dealing with major operations that are disappointing; they are too brief to be of value—for example, in that on the tongue there is no description of the operation for the removal of the affected lymphatic glands. Amongst surgeons in this country, importance is placed upon rendering the mouth free from dental sepsis, and there are certain writers who advocate the removal of all the teeth before carrying out major operations. This debatable subject is not touched on by the author. It has also become a practice to leave wounds in the mouth open, but if one judges the author correctly, he would appear to be in favour of packing with 5 per cent iodoform gauze over a fairly prolonged period.

The chapter on fractures of the jaw is too brief; there is a good description of fixation of the fracture by intermaxillary wiring, but scant reference to the methods of reducing some of the troublesome displacements met with from time to time. In the short chapter on plastic surgery the author insists—and rightly—on the restoration of teeth and bone by surgical or prosthetic means before carrying out plastic operations. A short account is given of maxillofacial prosthesis, and this includes an illustration of a lady putting the finishing touches on a 'reconstructed mask'.

The book, we feel sure, will be found of more value to the practitioner who limits his surgery to the minor operations of the mouth than to the one who undertakes the major operations.

Saint Bartholomew's Hospital Reports. Edited by W. McADAM ECCLES, Sir THOS. HORDER, Bart., K.C.V.O., Sir BERNARD SPILSBURY, W. LANGDON BROWN, W. GIRLING BALL, and GEOFFREY EVANS. Vol. LIX. Demy 8vo. Pp. 206 + xxviii. 1926. London: John Murray. 21s. net.

Of the papers of surgical interest in this volume that by Girling Ball on perforated ulcers in the stomach and the duodenum is the most considerable. The author collates some 500 cases, of which 50 have been under his own care; these are dealt with in detail and their symptomatology is critically analysed; their number, however, is too small to allow the author to draw any definite conclusions from the relative value of suture with or without short-circuiting.

In the treatment of true fractures of the neck of the femur Mr. Elmslie agrees with the line of treatment advocated by Whitman, and gives a useful review of the subject.

Though without direct surgical interest, the most fascinating paper in the volume is Sir D'Arcy Power's account of the rebuilding of the hospital in the eighteenth century, which will be eagerly read by all those interested in the history of such institutions.

Guy's Hospital Reports. Edited by ARTHUR HURST, M.D. Vol. LXXVI (Vol. VI, Fourth Series), Nos. 2 and 3. Royal 8vo. Pp. 125 (each). Illustrated. 1926. London: Wakley & Son (1912) Ltd. Annual subscription, £2 2s. net; single numbers, 12s. 6d. net.

THESE reports continue to reflect the work of the staff of Guy's Hospital. The outstanding feature is a continuation of "Studies on Tumour Formation", by G. W. Nicholson (in No. 2, Vol. VI, April, 1926). This article gives an account of tumours of endometrial origin, tumours found in the groin and round ligament, in the umbilicus, and in laparotomy scars. It is an article of great pathological interest.

Guy's Hospital Reports. Edited by ARTHUR HURST, M.D. Vol. LXXVI (Vol. VI, Fourth Series), No. 4, October, 1926. Royal 8vo. Pp. 120. Illustrated. 1926. London: Wakley & Son (1912) Ltd. Annual subscription, £2 2s. net; single numbers, 12s. 6d. net.

THIS volume contains an article of great interest to the general surgeon. This is an analysis of the results of treatment of carcinoma mammae by J. F. Carter Braine. The investigation concerns the fate of 722 patients admitted to Guy's Hospital during a period of thirteen years, namely, 1909-22. The following is Mr. Braine's summary of the analysis: "(1) In late cases the less extensive the operation the longer the life of the patient. (2) In late cases extensive operative interference leads to rapid dissemination and metastasis, and frequently does not confer a greater length of life than is to be expected when operation is withheld. (3) The operative mortality in all cases was 3.3 per cent. (4) Of all verified cases treated by operation, 54.1 per cent were alive at 3 years, and 28.4 per cent were alive at 5 years. (5) When the axillary glands were not invaded by growth at the time of operation, the prognosis was very materially improved: 86 per cent of such cases were alive at 3 years, and 46 per cent at 5 years. (6) When the axillary glands are invaded by growth the prognosis is less favourable; 45.8 per cent of such cases were alive at 3 years, and 18.8 per cent at 5 years. It is probable that the majority of the total number of cases in the series belonged to this category. (7) Superficial radiation applied immediately after the operation has definitely improved the prognosis of the disease. (8) More than half the recurrences after operation were found in the scar and adjacent skin, and more than a quarter in the axillary glands. Both were relatively early in their appearance."

Report on Third International Congress of Military Medicine and Pharmacy. By Commander WILLIAM SEAMAN BAINBRIDGE, M.C., United States Naval Reserve Forces, Member of Permanent Committee, Delegate from the United States. Demy 8vo. Pp. 111 + viii, with numerous illustrations. Reprinted from *The Military Surgeon*. 1926. Washington: Association of Military Surgeons.

THIS is a short report on the Third International Congress on Military Medical Subjects held since the war. The first was in Brussels in 1921, the second in Rome in

1923, and the third in Paris in 1925. At this last Congress forty-two countries were represented, but these did not include the Central Powers. More than 2500 delegates of the forty-two nations represented participated in the Congress, and there were in addition many visitors. The main subjects discussed at the present Congress were as follows: Technical specialization as the basis for the functioning of the medical services in war time; selection of the troops with especial regard to tuberculosis and affections of the ears and eyes; dressing and suture material; and the etiology and treatment of traumatic arthritis. There were also a number of short communications on special subjects.

The present report gives a good general idea of the scope and work of the Congress, and will enable anyone interested in any special subject to refer to the original and official transactions. The illustrations are chiefly photographs of prominent officials and groups of delegates who took part in the Congress.

Chronic Intestinal Stasis (Arbuthnot Lane's Disease). A Radiological Study. By ALFRED C. JORDAN, C.B.E. M.D. (Camb.), M.R.C.P. (Lond.), Corresponding Foreign Member, Belgian Royal Academy of Medicine. Second edition. 4to. Pp. 230 ÷ xv, illustrated. 1926. London: Humphrey Milford. 21s. net.

THE work is dedicated to Sir William Arbuthnot Lane, 'the Father of Stasis'. The latter, in a foreword to the book, states: "As time goes on the profession will see that the disturbances of metabolism, and the absorption of toxins from the gastro-intestinal tract, due to stasis, are of enormous importance: many surgical operations, at present needed, will fall into disuse. Early treatment is essential to prevent the many serious consequences of neglected stasis, most of which are graphically demonstrated in this work. Numerous diseases, at present the bane of civilized man, will disappear, once they are recognized to be the result of auto-intoxication and the conditions of life adapted to the preservation of healthy bodies. This is no utopian ideal, but the real foundation of medicine".

Dr. Jordan is well known as an original worker in radiology, and he has been prominent in the use of X rays almost since the original discovery by Röntgen. During the years that have elapsed he has been conspicuous by his original methods and technique, and he has advanced a number of theories in connection with diagnosis which must command our attention. The fact that many of the hypotheses he puts forward have not been universally accepted need not concern us in the estimation of his work on the whole, and in particular on the merits of this book. Much of the technique described is extremely sound, and with certain reservations it can be approved of as a method to follow in gastro-intestinal investigation, or as confirmatory of other methods. He has elaborated a thoroughly reliable method of screen examination, by the use of which he has made a number of observations of fundamental importance for the guidance of other workers. Many of the conclusions he arrives at in his book are the result of these screen observations, and as such they must be given a certain value. The radiographic evidence he puts forward is frequently not confirmatory of his screen observations, but such a criticism is applicable to the work of many other recognized authorities in radiology. The failure to confirm essential points made on the screen by radiographic reproduction need not be regarded as condemnatory of the former.

The methods of protection for the patient and the operator are reliable and worthy of adoption; the proof of the efficiency of the author's methods lies in the fact that he has used them for many years and has escaped serious damage. A further point is that Dr. Jordan introduced these methods at a time when the dangers were not generally appreciated and other workers were being damaged.

The work under review is in part the accumulated experience of years of active collaboration with Sir Arbuthnot Lane, and it is not surprising that many of the explanations given are based on the theories first enunciated by that eminent authority.

The book is more than a radiological study of chronic intestinal stasis; it also contains a section on treatment, and there is much in this part of the volume that

will be of service to the practitioner. The radiological portion of the work is sound, though not all radiologists will agree with many of the explanations given in the text of conditions which are commonly met with. Dr. Jordan is ambitious, and ventures into fields in which many able practitioners have wandered and become lost.

In the treatment of the manifold manifestations of the disease described in some detail, Dr. Jordan concludes: "I have endeavoured to point out the far-reaching consequences and dangers of neglected stasis, and shall conclude this chapter by outlining the means that should be taken to prevent the occurrence of cancer". The last part of this chapter is prophetic rather than useful. "Although we have not yet found the full solution of the cancer problem, may we not justly believe that we are at the dawn of a new era in the prevention of this dread disease?" Obviously Dr. Jordan believes that in putting forward chronic intestinal stasis as an explanation of the appearance of cancer, he is on sound ground; but it is asking too much to expect that these statements shall be taken seriously by research and clinical workers, who are diligently seeking for the cause and cure of cancer. It is difficult to follow the reasoning underlying the explanation of the production of toxæmia and sequelæ due to stasis in the alimentary canal; it is even more difficult to refute the conclusions, since many of them are ill-conceived, and based on an imperfect appreciation of physical laws and pathological conditions arising in association with stasis or, as is more probable, accompanying it. Is it logical in the first place to regard the condition as a disease, and from that hypothesis to ascribe such widely separated maladies as epilepsy, melancholia, suicidal mania, cancer of the breast, gall-stones, etc., to chronic intestinal stasis? On reasoning such as this there is practically no disease to which man is liable that cannot be explained by the effects of toxic absorption from the intestinal canal.

The volume under review is the second edition of the work; following so quickly on the first edition it is evident that the book has been widely read. Dr. Jordan is to be congratulated upon an interesting study of a condition of frequent occurrence in practice.

X-ray Diagnosis: A Manual for Surgeons, Practitioners and Students. By J. MAGNUS REDDING, F.R.C.S., Senior Surgical Radiologist to Guy's Hospital. Medium 8vo. Pp. 228, with 80 skiagraphic plates. 1926. London: Cassell & Co. Ltd. 21s. net.

THE author, in the preface of this admirable work, says: "In writing this book I have endeavoured to outline the guiding principles of radiographic diagnosis in the examination of those tissues whose structure renders them demonstrable by radiation. With this aim in view, the descriptions of the lesions affecting the different anatomical systems are preceded in every instance by an analysis of the appearances produced by the normal structure, and of the modifications of those appearances which result from disease. It is hoped that a basis for logical interpretation is in this way provided. It must be remembered that the ultimate aim of the examination is the formation of a reasoned diagnosis, and that without the requisite knowledge to arrive at this end the most perfect technical results are of no avail".

An author who sets out with such a clearly arranged objective, and succeeds in its execution as Dr. Redding has done, is bound to produce a work of some importance. In this instance the result is a handbook which amply fulfils the aims of its author, who states: "My hope is that the book may prove useful to the surgeon and the practitioner whose work brings them into constant touch with radiology, but who have had neither the time nor the facilities for making a special study of the subject; to the post-graduate preparing for the higher medical and surgical examinations and the diplomas in radiology now granted by the Cambridge and Liverpool Universities; and to the undergraduates studying for the pass examinations, to whose curriculum of obligatory subjects radiology has lately been added". For the purposes of the diploma candidates more information will be required on technique, but with this exception the candidate who masters the contents of the book should have no difficulty in satisfying the examiners. The

student, to whose burdens the science of radiology has been added, will find in its pages ample information for his needs.

The book is well planned; nothing of importance has been omitted, and much appears which will be of interest and use to the experienced radiologist, who time and again has to refresh his memory on essential points in anatomy and the interpretation of the normal and departures from it.

The illustrations are on the whole well chosen, and all are reproduced in half-tones on special paper, so there should be no excuse for any loss of detail in the reproduction of the skiagrams. One objection must be made; many of the skiagrams are reduced too much; detail is lost, and in several instances the size of the reproduction is out of all proportion to the space allowed on the plate; a larger size would have added to the value of the skiagrams. A number of the half-tones are below the average of first-class radiography of the present day. No doubt in a subsequent edition, which must soon be called for, these slight detractions will be removed, and better skiagrams take their place.

Mr. Redding has to be congratulated upon the result of his labours, and we welcome this work as a valuable contribution to radiography and one which will take a high place amongst the works on this subject in the English language.

Handbook of Medical Electricity and Radiology. By JAMES R. RIDDELL, F.R.F.P.S., Lecturer on Electrical Diagnosis and Therapeutics, University of Glasgow; Radiologist, West Infirmary, Glasgow, etc. Crown 8vo. Pp. 239, with 110 illustrations. 1926. Edinburgh: E. & S. Livingstone. 8s. 6d. net.

This book has been written with the object of providing the student with a short and simple description and explanation of the various radiotherapeutic, actinic, and electrical agents used in the treatment of disease. The description of apparatus and technique is clear and simple. The statements concerning the indications for various types of treatment are necessarily too brief and dogmatic to allow of any discussion—for example, it is a matter of opinion whether "Patients suffering from neurasthenia are improved by general applications of electricity in any form" (p.31). The diagrams of anatomy and apparatus are very good because of their simplicity, but the reproductions of radiograms are too small and indistinct to be of much value. Perhaps the author has attempted to cover too large a range of subjects in the compass of a small book, but he has succeeded in giving much useful information in a very readable form.

Light Treatment in Surgery. By Dr. O. BERNHARD (St. Moritz). Translated by R. KING BROWN, B.A., M.D., D.Ph., Medical Officer of Health, Bermondsey; Lecturer in Public Health, Guy's Hospital Medical School. Medium 8vo. Pp. 307, illustrated. 1926. London: Edward Arnold & Co. 21s. net.

DR. BERNHARD'S book, in the words of Dr. Leonard Hill in the foreword introducing the work, "is a masterly production, the fruit of thirty years' work, carried out by one of the greatest, if not the greatest pioneer of heliotherapy in the High Alps". Readers of the book in this country owe a great debt to Dr. King Brown, who has spared himself no trouble in giving a faithful and excellent rendering into English.

The book abounds in informative data of the important steps in the development of heliotherapy. The most striking tribute to individual effort on the clinical side is that Dr. Bernhard has limited the number of beds in his sanatorium to thirty-three, holding that such a number is essential to ensure each patient's receiving his individual attention. This may explain the evidence he puts forward of good clinical results, and the minute detail with which he describes the clinical conditions. Pioneer work in all branches of medicine calls for such meticulous care in its execution.

The opening chapter is historical, and is a delightful résumé of the uses of light treatment throughout the ages, from the classical days downwards. The chapter is a clear proof of the value of a sound classical education as a preliminary to the

study of medicine. Modern light therapy has been built on the third component of light, that is on the chemically active rays. The foundation stone was a knowledge of the bactericidal action of light.

An important chapter is that on light and light biology, in which many interesting points are discussed. The biology of light must ever be an important subject on which the basis of radiation therapy is founded. The experiments of Oerum and Bering are quoted as important in the explanation of the effect of light upon the blood. Oerum found that in rabbits kept in the dark and in red light there was a diminution in the number of red corpuscles and the hæmoglobin content, as well as a reduction of the quantity of the blood. Diffuse daylight and blue light, on the other hand, produced a considerable increase in the quantity of blood, along with an absolute increase of the total hæmoglobin. After a light bath of four hours rabbits showed a 25 per cent increase in the amount of their blood. The chemistry of light biology is dealt with in a most interesting manner.

The pathology of sunlight has a complete chapter devoted to it, and it precedes the description of the various forms of light treatment and the technique of their use. So the beginner is first initiated into the dangers arising from the injudicious use of these powerful rays. The important subject of light sensitizers is dealt with in a thorough manner, and the method of their action is explained. It is important to remember that exposure over a long period of time, though intermittent, may lead to the development of chronic dermatitis, but Bernhard is not inclined to agree that carcinoma may supervene in these cases. At the end of the chapter on light therapy several important rules are enumerated under headings: (A) Local irradiations; and (B) General irradiation.

Light therapy is dealt with under these main headings: (A) Sunlight therapy; (B) Therapy with artificial sources of light. The latter gives a full description of the forms of lamp used. A short reference is made to the Röntgen rays; further on in the book the use of these rays is dealt with in detail in connection with the treatment of surgical tuberculosis.

This handbook is a most complete treatise on the increasingly important subject of light treatment in surgery, and as such it is incomparably the best yet published. It is most instructive in its detail and full of the most convincing arguments in favour of the use of these powerful aids to surgical treatment.

The author is an accomplished physician, well versed in the historical developments of his subject, a man of profound learning, and an able clinician. The clinical data have been dealt with in a most painstaking manner; the result is a very informative treatise, which must be of the greatest service to all who are interested in this work. The author is to be heartily congratulated on the able manner in which he has put on record the summation of the labour of years, and his book cannot fail to meet with universal approval.

L'Anesthésie tronculaire des Machoires, par Voie buccale. By Dr. ROGER DUCHANGE. Medium 8vo. Pp. 112, with 24 illustrations. 1926. Paris: Masson et Cie. Fr. 2 (suisses).

This small monograph is by the same author as the important work on fractures of the jaws and their treatment. It consists of a careful and detailed account of the anatomy of the nerve-supply of the lower and upper jaws and of the methods of injecting local anæsthetic solutions through the oral approach into the nerve canals. A few line drawings serve to illustrate the main anatomical facts. In discussing the most important problem—namely, the practicability of injecting the foramen ovale—the author advises the use of a special gag and guide, and it is unfortunate that the illustration of this in use (*Fig. 8*) is very far from clear.

Except in cases where actual infection has occurred in the track which would have to be followed by the needle, and in cases of intractable trismus, the author considers that regional anæsthesia should be used for all jaw operations. We believe that few patients would share this view if they understood the pros and cons of alternative methods.

Handbuch der Massage und Heilgymnastik. By Dr. FRANZ KIRCHBERG, Lecturer in Massage at the University of Berlin. Vol. I. Royal 8vo. Pp. 274, with 71 illustrations in the text and 19 plates. M. 14.70. Vol. II. Pp. 334, with 23 illustrations. M. 15.

Massage und Gymnastik im Dienste der Kosmetik. By Dr. FRANZ KIRCHBERG. Crown 8vo. Pp. 99 + v, with 29 illustrations. 1926. Leipzig: Georg Thieme. M. 3.90.

THESE two books on massage and remedial exercises give a very full and complete account of the subject. In the handbook an introductory account is given of the history of the art of massage, tracing it back to Chinese and Indian, Greek, and Roman practice. Continued on more or less empirical lines through the Middle Ages, it was raised to the standard of an exact science by Henrik Ling, to whom Sweden owes her fame in regard to this subject. The first volume is concerned with a description of the technique of massage and a discussion as to its mode of action, and is exceedingly thorough and clear in all details. The plates at the end of the volume are from photographs illustrating the different kinds of massage and movements.

The second volume of the handbook deals with the application of massage and exercises in the treatment of various diseases and injuries. The following organs or system of organs are discussed in their relation to massage: circulatory system: abdominal organs, especially with regard to enteroptosis and constipation: organs of respiration: urino-genital apparatus: nervous system, including the treatment of various types of paralysis: bones, muscles, and joints, including fractures and sprains; the auditory apparatus: and the mucous membrane of the upper air-passages.

Drs. Koch, Seele, Koblanek, Echtermeyer, and Professor Grossmann have collaborated in special subjects, i.e., fractures, dislocations, diseases of women, aural surgery, and nasal surgery. The handbook is a most useful guide to practice, and invaluable as a book of reference.

The small book by Dr. Kirchberg on massage in relation to beauty preservation is apparently an attempt to supply information to those who take up this type of practice without a general training..

Die akuten eitrigen Infektionen in der Chirurgie und ihre Behandlung. By Dr. ARTHUR BUZZELLO. Royal 8vo. Pp. 495, with 175 illustrations. 1926. Berlin and Vienna: Urban & Schwarzenberg. Bound, M. 34.50; unbound, M. 30.

THE intention of this work is to provide for the student and young practitioner a guide both in the understanding of the acute suppurative infections of surgery and in modern methods of treating these conditions. This is a branch of surgical work from which the general practitioner earns his 'daily bread', and, to some extent, the teaching of the student is here deficient, because a very large amount of his time is spent on the more easily taught subjects which are of greater interest to the specialist. This, no doubt, is truer in schools where the specialist clinic system is most developed, but in Britain, where the surgical teaching is done largely by general surgeons, the problem is not so acute as that pictured by Dr. Buzzello for the Continent.

In this book there is first a chapter dealing with general aspects of the subject, including sections on nomenclature, body defences, bacteriology of the pyogenic organisms together with elementary laboratory technique, and special methods of treating suppurative conditions. The main part of the volume deals systematically with the suppurative infections under the following headings: wound infection, skin and subcutaneous tissues, whitlow, bones and joints, bursæ, lymphatics, connective tissues and glands (including the breast, kidney, lachrymal sac, spleen, prostate, etc.), mucous membranes, blood-vessels, pleura and peritoneum (including empyema, lung abscess, subphrenic abscess, appendicitis, cholecystitis, peritonitis, and pelvic abscess), decubitus, tetanus, anthrax, and noma. Finally, there is a chapter on the septic general infections.

As in all such piecemeal books for the student, it is possible to bring forward criticisms in the way of errors of both omission and commission in the choice of subjects. Apart from this, we would have desired fuller details of treatment in some subjects—e.g., the Carrel-Dakin method of wound irrigation and treatment with B.I.P.P. The chapter on whitlow would have been much better if reference had been made to Kanavel's work on the infections of the hand. Nevertheless, the general standard of the book is excellent.

Ausgewählte chirurgisch-klinische Krankheitsbilder. From Sauerbruch's clinical lectures. Arranged by Professor Dr. GEORG SCHMIDT. Part I. Crown 8vo. Pp. 84. 1926. Berlin: Julius Springer. Reichsmarks 2.70.

THIS little pamphlet is the first of a series, and consists of a selection of ten clinical lectures of Sauerbruch. They cover the following ground: exophthalmic goitre, endemic cretinism, burns, carcinoma of the breast, hydrocele, prostatic hypertrophy, congenital talipes, perinephritic abscess, carcinoma of the tongue, and hare lip. Enabling the listener to get a picture of the disease in all its aspects, and conveying to him personal views of the lecturer, this is a very valuable form of surgical teaching. The above are perfect models of what such should be; and, although in the printed word some of the 'atmosphere' of the clinical lecture is of course lost, Dr. Schmidt is to be congratulated on giving us so great an insight into the methods and personality of such a distinguished teacher.

Die Vorbereitung zu Chirurgischen Eingriffen. By Dr. JOH. VOLKMANN, Privatdozent in the Surgical Clinic of the University of Halle. Medium 8vo. Pp. 238 + x. Illustrated. 1926. Berlin: Julius Springer. Reichsmarks 12.

THIS is a small work dealing with the examination and preparation of patients before operation, and is intended for students, medical practitioners, and young assistants, who find themselves in the position of having to handle patients alone and without previous experience. It is a compact and comprehensive volume and may be useful to those who read German.

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FASCICULUS II.

DISEASES OF THE STOMACH.

Compiled by E. K. MARTIN, M.S., F.R.C.S.

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SYPHILIS OF THE STOMACH.

A stomach, with portions of the œsophagus and duodenum, divided along the greater curvature.

The greater part of the mucous surface is ulcerated, the main ulcer extending from cardia to pylorus along the lesser curvature and spreading over the adjoining parts of both anterior and posterior surfaces. The outline of this ulcer is irregular and the edge is raised. From the smooth floor rise prominent islands of granulation tissue covered with ragged sloughs. On the anterior surface are three oval perforations with sharply-cut edges.

The stomach is adherent to the liver in front and to the pancreas behind. Its wall is thickened, in places to over half an inch, and, on section, the thickening is seen to be in the submucosa, which is white in colour. The volume of the stomach was slightly decreased. The associated lymph glands were small, and normal on section.

Museum of University College Hospital, 3055.B

MICROSCOPIC STRUCTURE.—The thickened wall in relation to the ulcer shows interruption of the muscular coat by granulation tissue, round-celled infiltration along the smaller arterioles, and endarteritis obliterans of arteries and arterioles. Spirochaetes morphologically identical with the *Treponema pallidum* were present in the granulation tissue.

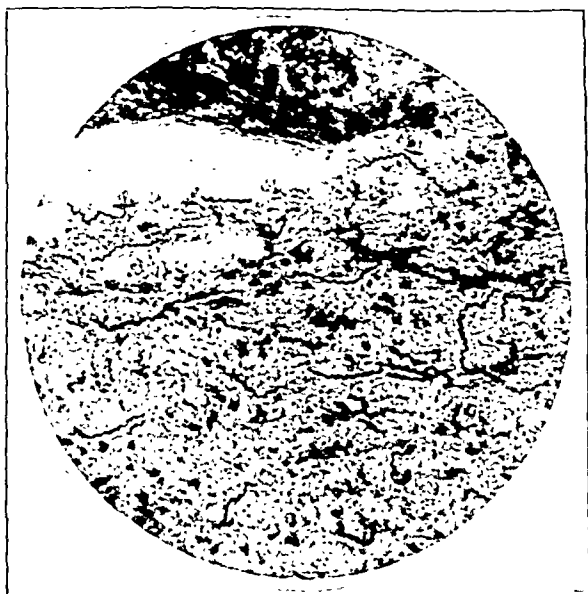
CLINICAL HISTORY.—The patient was a man, aged 57, who had suffered from pain in the abdomen and chest for six months, with alternating constipation and diarrhœa. There was no free HCl in the stomach contents. Death followed perforation of the ulcer.

AUTOPSY.—No other lesions suggestive of syphilis.

(McNee, *Quarterly Journal of Medicine*, 1922, xv, 59.)

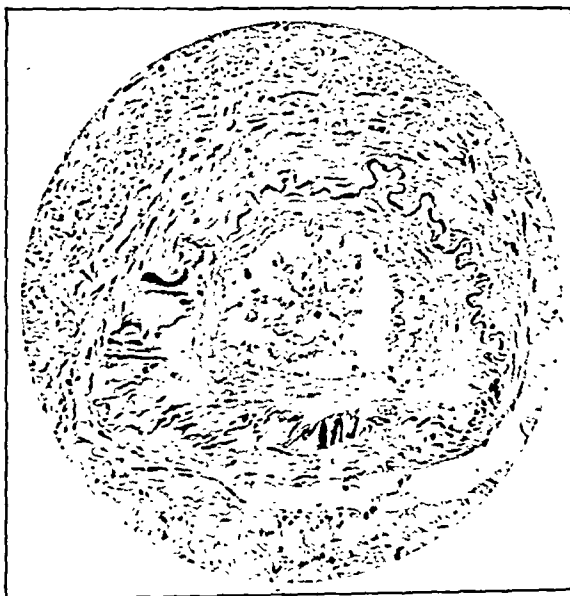


SYPHILIS OF THE STOMACH, *continued.*



Retouched microphotograph of a section, showing the character of the spirochaetes. Stained by Levaditi's method. ($\frac{1}{2}$ -inch oil-immersion lens, No. 4 eyepiece.)

Microphotograph of a small artery in the floor of the ulcer, showing endarteritis obliterans. Hæmalum and eosin. ($\times 50$.)

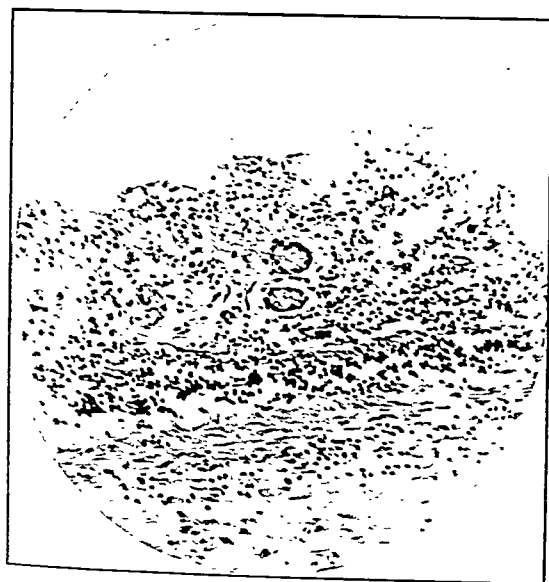
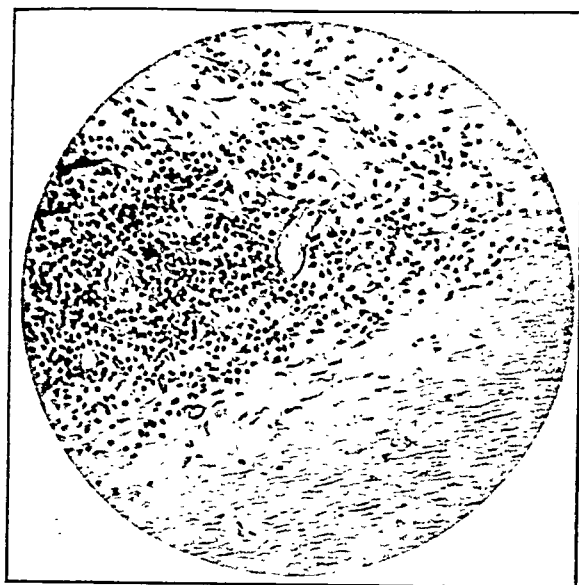


MUSEUM OF UNIVERSITY COLLEGE HOSPITAL, 3055.B

(Reproduced by permission from the 'Quarterly Journal of Medicine'.)

SYPHILIS OF THE STOMACH. *continued.*

Microphotograph of a moderately active part of the ulcer, showing the granulation tissue. Part of the muscular coat of the stomach is seen below. Hæmalum and eosin. ($\times 50$.)



Microphotograph of the mucosa of the stomach in a part not involved by the ulcer. The changes are those of interstitial gastritis, and the muscularis mucosæ remains intact. Hæmalum and eosin. ($\times 50$.)

MUSEUM OF UNIVERSITY COLLEGE HOSPITAL, 3055.B

(Reproduced by permission from the 'Quarterly Journal of Medicine'.)

V. CARCINOMA OF THE STOMACH.

The stomach, the uterus, and the breast are the three organs of the body in which carcinoma is most common, and among these three the stomach has attained an unenviable notoriety because of the difficulty with which its earlier symptoms are appreciated by the patient. In the majority of cases it appears between the ages of 40 and 60, and it affects more males than females in the proportion of about 3 to 1.

Carcinoma usually commences in a previously healthy stomach, but in a definite and important proportion of cases it is preceded by and arises in direct connection with a simple, chronic ulcer. The exact numerical proportion of cases in which this latter event occurs has been the subject of widely divergent statements; but although gastric ulcer is at present the only known cause of gastric carcinoma, it is probable that at least nine-tenths of all carcinomas arise in stomachs which have never contained an ulcer.

The common site of carcinoma of the stomach is on the lesser curvature, near the pylorus. It seldom commences at the pylorus itself or at the cardiac orifice, or indeed in any part of the stomach other than the lesser curvature. Occasionally two growths of similar size are found on opposed surfaces of the stomach.

The naked-eye appearance of a carcinoma of the stomach may vary within wide limits according to the form assumed by the disease. The chief types met with are the malignant ulcer, the 'leather-bottle' variety, and the fungating tumour.

The malignant ulcer, when examined from the peritoneal aspect, is not easily differentiated from a simple, chronic ulcer, unless its characteristic features, such as a raised, everted, and irregular edge, are fully developed, or the carcinoma has reached the peritoneal surface, or has produced metastases in lymphatic glands, liver, or peritoneum. On examination of the cut surface of a section through the growth, it is usually possible to trace the muscle of the stomach wall across the base of the ulcer, even though it may be extensively invaded by growth. This appearance contrasts with the complete interruption of the muscular coat by a simple, chronic ulcer.

The 'leather-bottle' type of carcinoma commences as a rule on the lesser curvature near the pylorus, and spreads both around the circumference of the stomach and along its axis towards the cardia by infiltration of the submucosa. The stomach retains its general shape, but may be greatly reduced in capacity, both by the thickening of its wall and by the contraction which occurs in the fibrous tissue which forms the bulk of the thickened submucosa. When the whole stomach is involved it becomes converted into a rigid tube, incapable of dilation, and the pyloric and cardiac sphincters may become fixed in a half-open position. On external examination the peritoneal coat, except for a general loss of translucency, usually shows no traces of carcinoma, owing to the strict limitation of the infiltration to the submucous layer. The regional lymphatic glands are seldom much enlarged. On the mucous surface there may be one or more ulcers in the older parts of the growth, but, for

the most part, the mucous membrane preserves its usual character over the irregular thickenings of the submucosa.

The *fungating tumour* is a much less common variety of carcinoma of the stomach than is the malignant ulcer. It is found in any part of the organ, and, in its most characteristic form, arises by a relatively narrow pedicle from the region of the greater curvature. The lobulated tumour which results is superficially ulcerated, and may produce obstruction to the passage of the gastric contents in virtue of its bulk. Apart from the base of attachment the wall of the stomach is not infiltrated by carcinoma, and enlargement of lymphatic glands is minimal.

The spread of all forms of carcinoma within the stomach takes place mainly in the submucosa, and the general direction is away from the pylorus along the lesser curvature towards the cardia. On the duodenal side the progress of the growth ceases abruptly at the pylorus, and it is but rarely that the wall of the duodenum is infiltrated, though a process from a bulky tumour may project through the pyloric opening into the lumen of the duodenum. The lower end of the œsophagus does not share the immunity of the duodenum to invasion. Infiltration of the submucosa on the cardiac side usually extends for an inch or more in advance of the apparent growing edge, and ulcerated nodules of carcinoma of macroscopic size may appear as outcrops at a distance from the main growth.

In addition to infiltrating the submucosa, carcinoma invades the muscle lying deep to its point of origin, and splits it up into paler blocks separated by white lines which run at right angles to the serous surface. When it reaches the peritoneal surface carcinoma produces a puckered and injected area in which are white nodules and plaques of growth.

Direct extension beyond the limits of the stomach follows adhesion to surrounding structures, among which the transverse colon and its mesocolon are commonly involved in the later stages of the disease. The great omentum, where attached to a carcinomatous portion of stomach, may be involved by both direct and lymphatic spread. The pancreas is seldom invaded.

Lymphatic spread commences early, and is often the factor which determines the possibility of removal of the disease by operation. In the common form of carcinoma of the lesser curvature near the pylorus, the first lymphatic glands to become enlarged are those in the omenta above and below the pylorus. From these the spread is usually progressive along the lymphatics which run as satellites of the blood-vessels supplying the stomach, and the upper coronary group and the glands along the gastroduodenal and hepatic arteries become involved. The upper coronary group of glands are occasionally infected by lymphatics which pass direct from the pyloric end of the lesser curve. In the later stages the glands in the portal fissure and around the celiac axis may become affected, and, from the latter, carcinoma occasionally may spread up the thoracic duct to the glands at the root of the neck on the left side.

The liver is a common site for secondary deposits in advanced cases, and it is probable that these are carried by the portal blood-stream.

Peritoneal dissemination may occur at any time after the growth has reached the serous surface of the stomach. The common form of peritoneal

involvement is that in which small nodules are scattered, at first in the neighbourhood of the stomach, and later widely throughout the abdominal cavity. In other cases the pelvic viscera become the seat of carcinomatous masses before general peritoneal involvement occurs, as if the cells were conveyed from the upper abdomen to the pelvis through the influence of gravity. Rarely, a diffuse induration of the peritoneal coat of the intestines is observed.

The effects on the stomach of the growth of a carcinoma within its walls are, in many respects, similar to those which result from the presence of a chronic ulcer. These effects depend upon the destructive process of ulceration and upon the distortion produced by contraction of the fibrous stroma of the growth. Thus, perforation into the peritoneal cavity, though not common, is a well-recognized cause of death in carcinoma of the stomach. Severe hæmorrhage from erosion of a large vessel is rare, but continuous slight loss of blood is a frequent accompaniment of malignant ulceration. Stenosis from contraction occurring in a scirrhus carcinoma is most often seen at the pylorus. With a growth of corresponding type in the middle of the lesser curvature an hour-glass deformity is produced.

The epithelial cells of which a carcinoma of the stomach is composed may be of spheroidal or columnar shape, and examples of both types of cell often occur in the same tumour. Growths composed wholly or mainly of columnar cells are of the fungating type and are relatively soft. The cells are frequently so arranged as to resemble irregular and atypical glands, and the fibrous stroma is seldom dense.

Spheroidal-celled carcinoma presents great variation in the quantity and density of its connective-tissue stroma, and may appear to the naked-eye as an ulcer, a 'leather-bottle' type of induration, or a fungating tumour. When the fibrous stroma is abundant and mature it shows a strong tendency to contract—sclerosing or scirrhus carcinoma—and in doing so produces the characteristic deformities of pyloric stenosis, 'hour-glass' constriction, and the shrunken form of 'leather-bottle' stomach.

Both spheroidal-cell and columnar-cell carcinoma are liable to colloid degeneration in a small proportion of cases. Colloid or mucoid degeneration affects both the epithelial cells of the tumour and the connective-tissue cells of the stroma, and adds to the bulk of the tumour without affecting its malignancy.

In all forms of carcinoma of the stomach some degree of interstitial gastritis is present. The intensity of the inflammation of the mucous membrane runs parallel to that of the ulceration of the growth, and is accentuated by the retention of gastric contents which follows the development of pyloric stenosis. In the terminal stages of the disease an acute suppurative or sloughing gastritis may lead to considerable modifications in the appearance of the mucous surface of the stomach when specimens obtained by autopsy are compared with those which have been removed at operation.

The X-ray picture of carcinoma of the stomach is usually conclusive, except in the early stages of carcinoma developing at the site of a simple, chronic ulcer. The most characteristic appearance is that of the 'filling defect', an indentation in the shadow of the stomach produced by the projection of the tumour from the wall into the lumen of the organ. The 'filling

defect' gives an accurate outline of the shape of a malignant ulcer or of a fungating tumour. If pyloric stenosis has been caused by a contracting scirrhus carcinoma, there is an irregularity in the outline of the pyloric antrum, and, in addition, a diminution or absence of peristalsis in the portion of stomach which shows the irregularity of shape. When the pylorus has been fixed by carcinomatous infiltration in a half-open position, the appearances are similar, except that there is no obstacle other than the damping of the peristaltic wave to the passage of gastric contents into the duodenum.

The X-ray picture of a malignant 'hour-glass' deformity differs from that of a similar deformity caused by a simple ulcer in the absence of the characteristic 'niche', in the irregularity and rigidity of the constricted portion of stomach, and, usually, in the absence of dilatation of the proximal pouch.

The X-ray appearance of a 'leather-bottle' stomach is equally characteristic whether the stomach is in the usual contracted condition or has retained its normal size. In the common form the shadow of the stomach is high in the abdomen, fixed in position, and diminished in size, while it retains an approximately natural shape. The most characteristic feature is the absence of peristaltic waves, owing to inability of the muscular coat to deform the infiltrated and rigid submucosa.

CARCINOMA OF STOMACH.

('HOURLASS' DEFORMITY.)

The greater part of the anterior wall of a stomach with attached portions of the omenta. The posterior wall has been removed.

About the middle of the lesser curvature is a carcinomatous ulcer which has encircled the stomach and produced an 'hour-glass' deformity. The growth extends more towards the cardia than towards the pylorus. The muscular coat of the stomach is hypertrophied, but its lumen is not dilated. There is an enlarged gland below the pylorus.

On the peritoneal surface the growth appears as a yellow plaque with well-defined, thickened edge, and puckered centre. The surrounding peritoneum is hyperæmic.

Museum of University College Hospital, 9.S.1

CLINICAL HISTORY.—The patient was a woman, aged 49, who was wasted to 5 stone, and for three months had had pain one hour after food. The pain was relieved by vomiting. At the age of 22 she was treated medically for twelve months on account of pain after food, but had had no gastric symptoms during the intervening period. There was a hard movable mass above and to the left of the umbilicus, with visible gastric peristalsis.

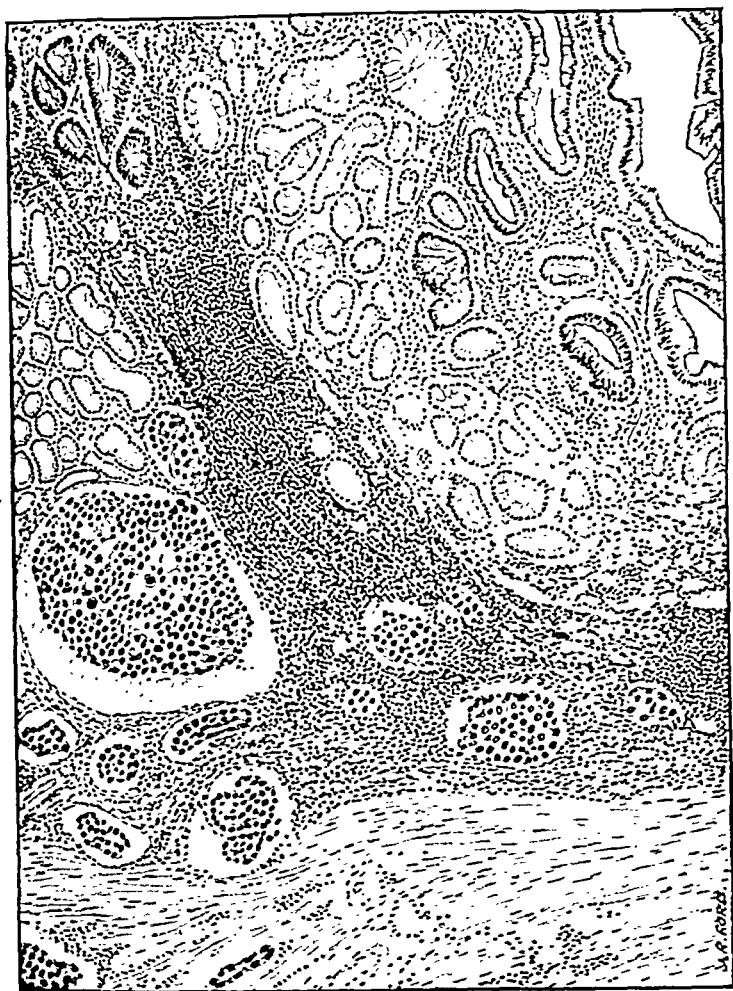


PERITONEAL SURFACE.



SECTION.

MUSEUM OF UNIVERSITY COLLEGE HOSPITAL 9.S.1



× 75

MICROSCOPIC STRUCTURE.—Drawing of the edge of the growth. The section includes the deeper layers of the mucosa and the muscularis mucosæ. The carcinoma is of the spheroidal-celled type, and its junction with the normal mucous membrane is marked by a zone of round-celled infiltration.

In other parts of the section the growth extends through the submucous and muscular coats.

Museum of University College Hospital, 9.S.1

CARCINOMA OF STOMACH.

(SUPERVENING ON SIMPLE CHRONIC ULCER.)

The posterior half of the pyloric end of a stomach, with attached portions of the omenta.

In the middle of the specimen, near the greater curvature, is a gastrojejunostomy opening. Between this and the pylorus the submucosa is irregularly thickened by a white growth, over most of which the mucous membrane can still be traced. The muscular coat of the stomach in the region of the growth is hypertrophied, and, along the greater curvature, is invaded by white lines of carcinoma.

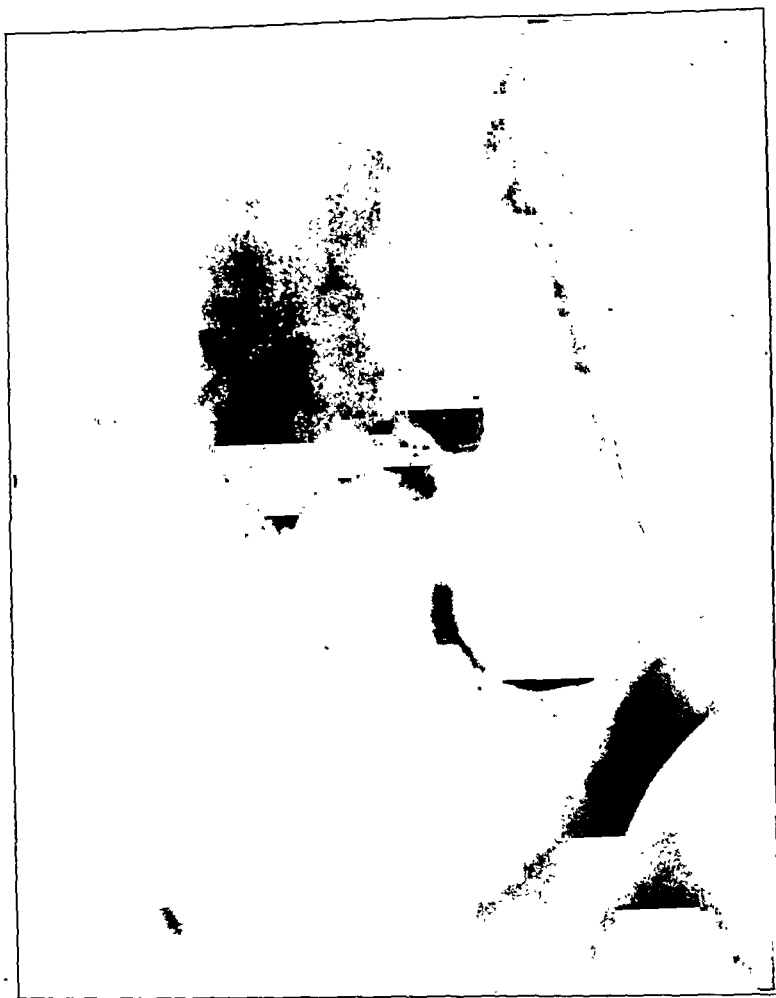
On the lesser curvature, close to the pylorus, the muscular coat is interrupted for a distance of $\frac{1}{4}$ in. by a block of fibrous tissue which probably indicates the site of an antecedent, simple, chronic ulcer.

On the peritoneal surface of the specimen the swelling and a slight increase of opacity are the only visible indications of the presence of a growth. One slightly-enlarged lymphatic gland is present below the pylorus.

Museum of University College Hospital, 13620

CLINICAL HISTORY.—The patient was a woman, aged 50, who had been treated for 22 years for indigestion, flatulence, and vomiting. Six years before partial gastrectomy she had had a gastrojejunostomy performed for pyloric stenosis due to a chronic ulcer of the lesser curvature close to the pylorus. After the operation she remained free from symptoms for $5\frac{1}{2}$ years, and then began to vomit and to lose weight. On admission to hospital there was a hard, movable tumour in the pyloric region.

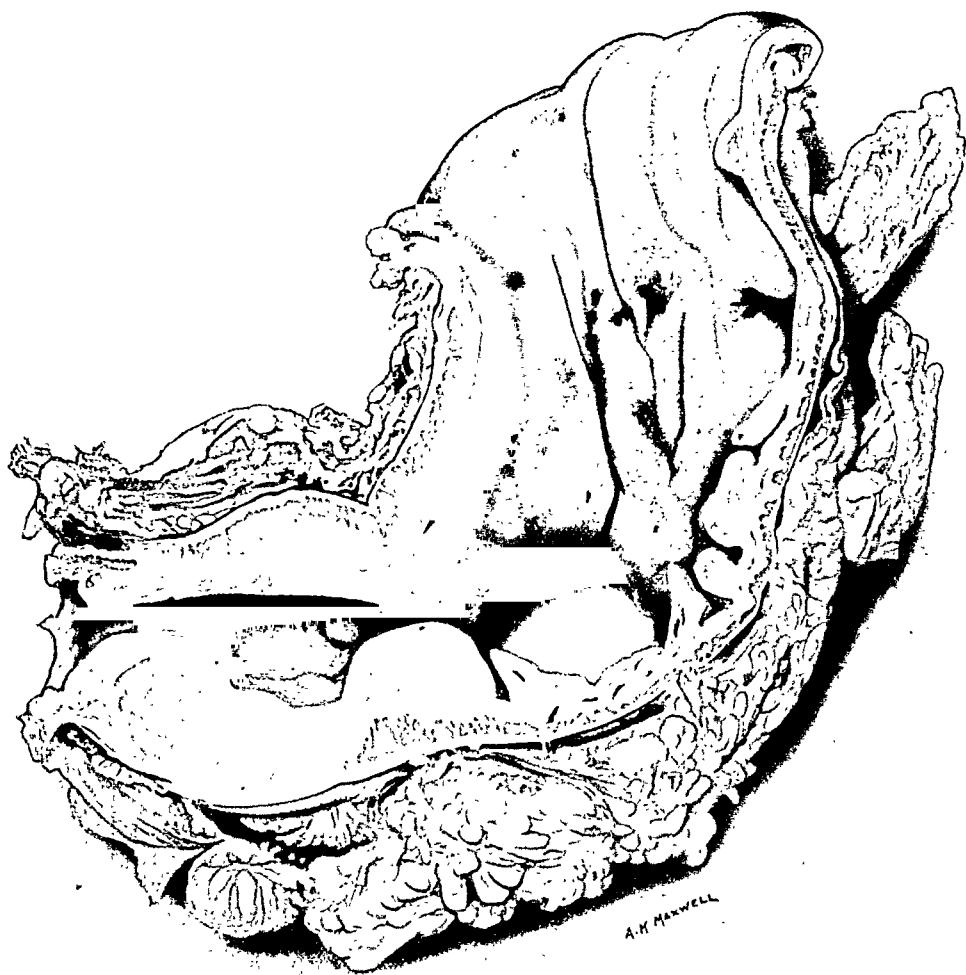
X-ray examination after a barium meal showed that the stomach emptied readily through the gastrojejunostomy opening, but that no barium had passed into the portion of stomach between the stoma and the pylorus. The specimen illustrated was removed by operation.



X-ray photograph in upright position immediately after a barium meal.

The proximal part of the stomach as far as the gastrojejunostomy opening is filled and the meal is passing freely into the jejunum. No barium has entered the pyloric portion of the stomach, which could be felt passing horizontally to the right above the efferent loop of jejunum.

Museum of University College Hospital, 13620

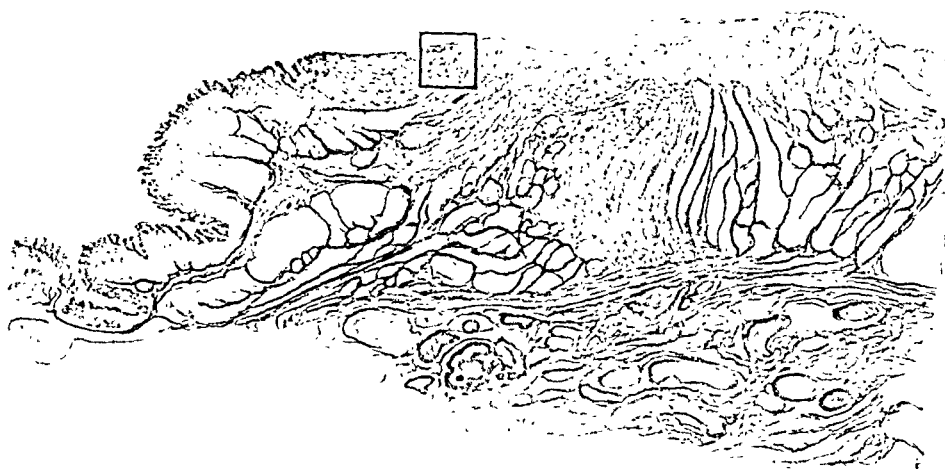


SECTION.



PERITONEAL SURFACE.

MUSEUM OF UNIVERSITY COLLEGE HOSPITAL, 13620

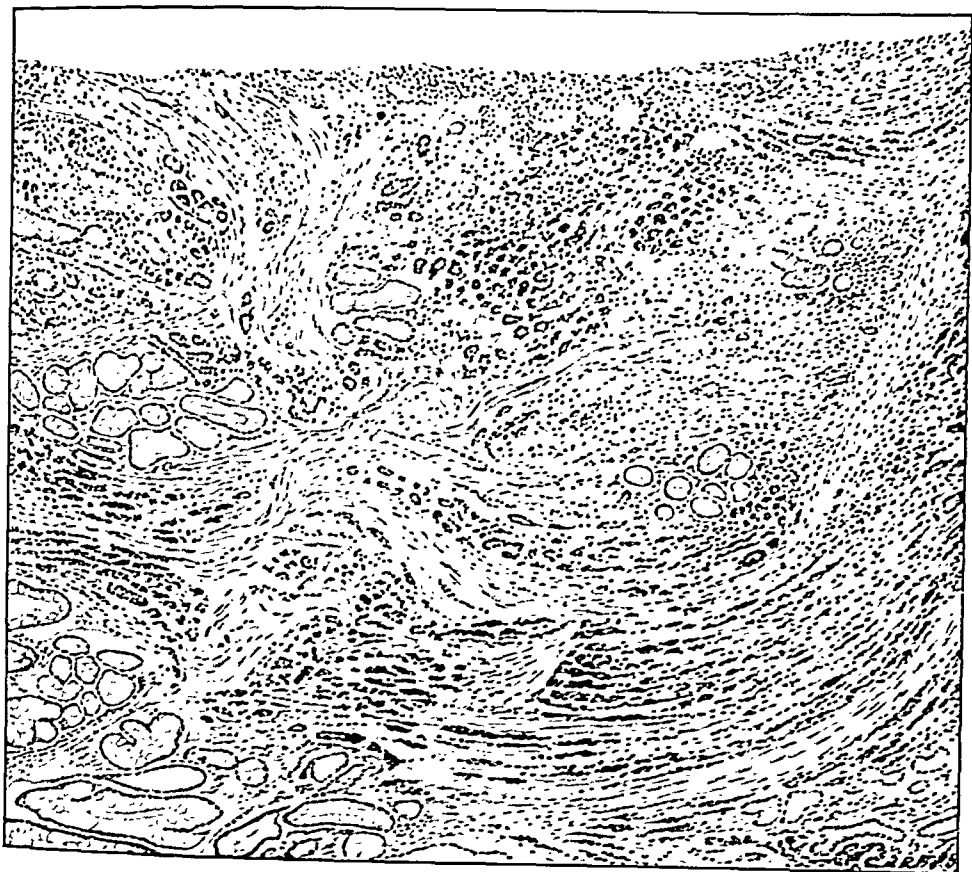


× 5

MICROSCOPIC STRUCTURE.—Drawing of a section taken from the lesser curvature at the pylorus.

The site of the simple, chronic ulcer is indicated by a vertical bar of fibrous tissue which interrupts the continuity of the muscular coat. (Van Gieson stain.)

Museum of University College Hospital, 13620



× 75

MICROSCOPIC STRUCTURE.—Drawing of the portion outlined by the rectangle on page 114.

The edge of a scirrhus carcinoma is invading the mucous membrane on the pyloric side of the scar of the simple ulcer.

Museum of University College Hospital, 13620

CARCINOMA OF STOMACH.

(‘LEATHER-BOTTLE’ TYPE.)

The lower part of the œsophagus and the stomach with attached portions of the omenta. The œsophagus has been divided down the front and the interior of the stomach has been exposed by removal of its anterior wall.

The cut surface of the stomach shows the submucosa thickened by infiltration with white growth. The malignant change has commenced at the pylorus, and has extended throughout the whole length of the lesser curvature, but has involved only about two-thirds of the greater curvature. The mucous surface is raised into irregular nodules, and is divided into two parts by a low ridge which marks the limit of submucous infiltration in the body of the stomach. To the pyloric side the surface is ulcerated and covered by sloughs ; to the cardiac side the mucous membrane is acutely inflamed, but is not ulcerated.

Beyond the pylorus, the submucous infiltration by carcinoma and the ulceration of the mucosa extend into the duodenum as far as the first valvulæ conniventes. The cardia is widely dilated, and the lower part of the œsophagus is in a condition of acute, ulcerative inflammation. Both omenta are thickened and contain lymphatic glands enlarged by growth.

Museum of University College Hospital, 3060

MICROSCOPIC STRUCTURE.—Spheroidal-celled carcinoma.

CLINICAL HISTORY.—The patient was a woman, aged 45, who had suffered from indigestion, without actual pain, for three months. Eighteen days before death she commenced to vomit immediately after food, and this vomiting continued to the end. She was moribund when admitted to hospital, and was vomiting dark brown, offensive, watery fluid. Pressure on a mass, which was felt in the upper abdomen, at once caused further vomiting.

AUTOPSY.—Secondary deposits of growth were present in the peritoneum, anterior mediastinum, and diaphragmatic pleura.



MUSEUM OF UNIVERSITY COLLEGE HOSPITAL, 3060

CARCINOMA OF STOMACH.

(FUNGATING TYPE.)

A stomach opened by removal of its anterior wall.

A fungating tumour arises from a narrow base on the greater curvature and has grown up the anterior and posterior walls of the stomach, leaving a central channel running longitudinally through it. A process of the tumour extends through the widened pylorus into the duodenum, to the walls of which it is not attached.

The growth is lobulated and superficially ulcerated. The muscular coat of the stomach is hypertrophied. Its mucous membrane appears normal up to the edge of the tumour. On the peritoneal aspect the attachment of the base of the carcinoma is outlined by a groove.

Museum of University College Hospital, 13.S.2

CLINICAL HISTORY.—The patient was a woman, aged 50, who had been wasting for eighteen months, had had diarrhoea for seven months, and had suffered from gnawing pains in the epigastrium for four months. The pain was relieved by food, and her appetite had been fair throughout. There was no vomiting. In the umbilical region there was a hard, nodular tumour, which moved with respiration. Exploration showed numerous glands enlarged by growth along both curvatures.



MUSEUM OF UNIVERSITY COLLEGE HOSPITAL, 13.S.2



× 12

MICROSCOPIC STRUCTURE.—The section has been taken from the edge of the attached base of the tumour, and shows the general structure. The cells of the carcinoma are mostly columnar in shape, and arranged so as to form irregular acini. Among these are masses of spheroidal cells, many of which are structureless from degeneration.

Museum of University College Hospital, 13.S.2

CARCINOMA OF STOMACH.

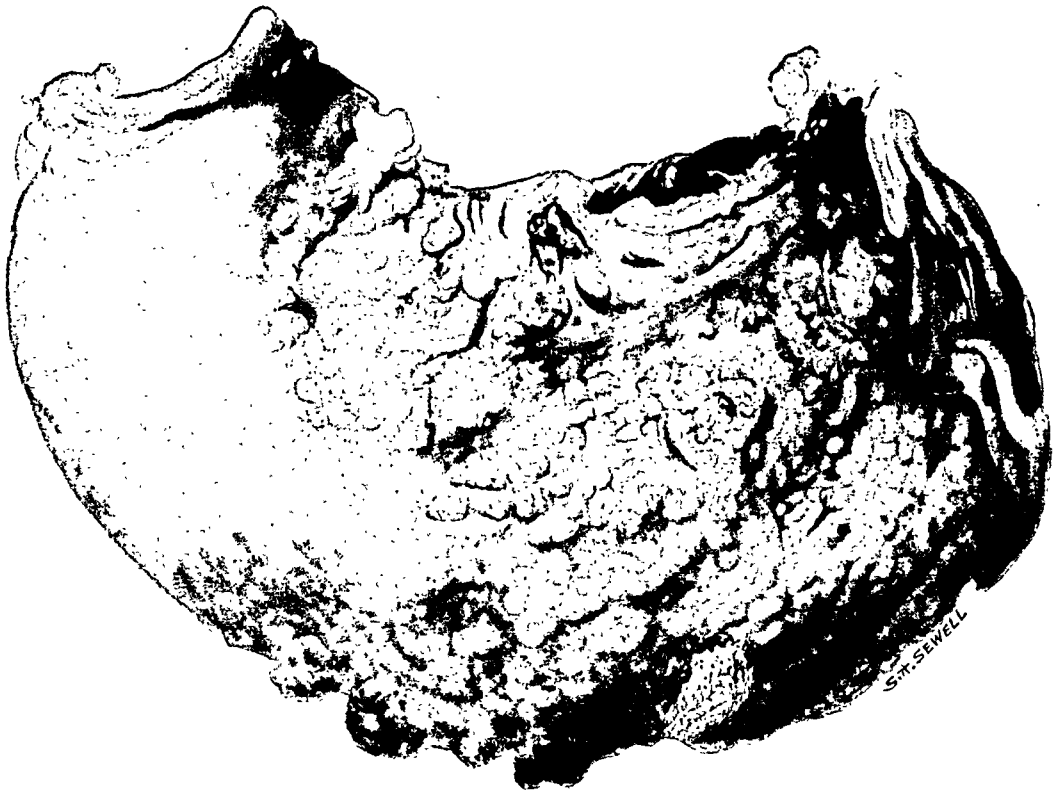
(COLLOID DEGENERATION.)

A stomach seen from the peritoneal surface and in section.

On the peritoneal side translucent nodules of growth are thickly studded around the cardia. In the section the coats of the stomach, especially the submucosa, are thickened by infiltration with carcinoma, which has undergone extensive colloid degeneration.

Pathological Museum, University of Sheffield, H. XIV. 15

No clinical history is attached to the specimen.



PERITONEAL SURFACE.



SECTION.

PATHOLOGICAL MUSEUM, UNIVERSITY OF SHEFFIELD, H. XIV. 15

CARCINOMA OF STOMACH.

Portions of the pyloric end of a stomach.

The smaller drawing shows a transverse section through the growth. The mucosa is converted into a broad band of cancerous tissue, and the inner muscular coat is extensively infiltrated. The larger drawing shows an interior view of the upper portion of the growth, which is centrally ulcerated and has raised nodular congested margins.

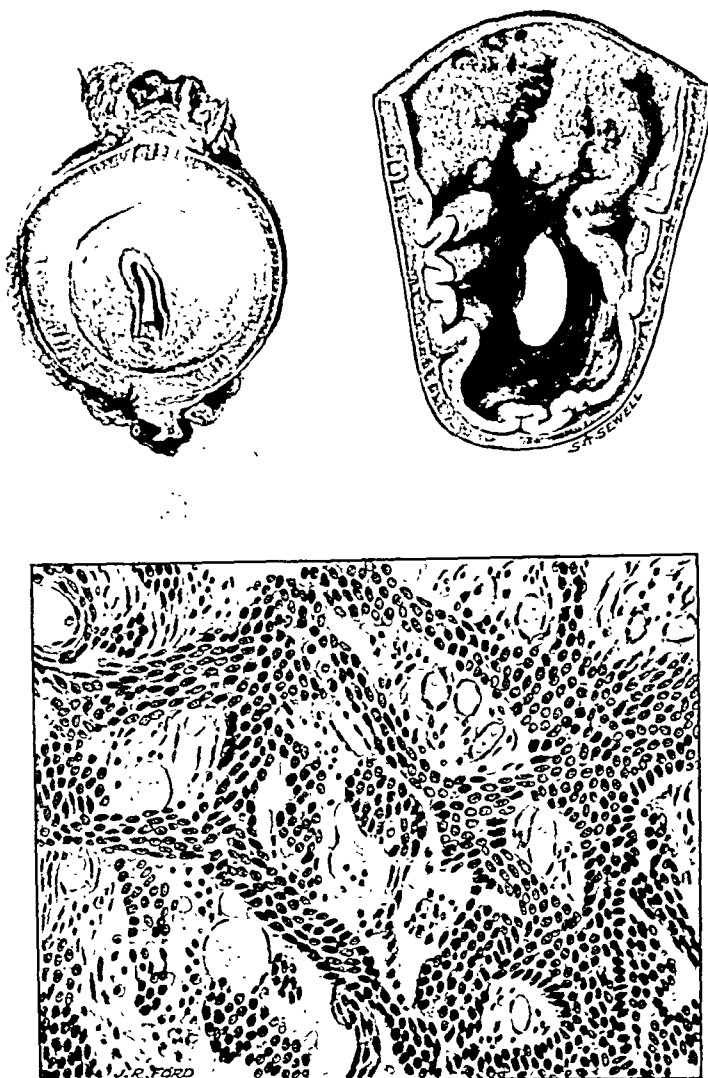
Pathological Museum, Leeds School of Medicine, E.220.E

MICROSCOPIC STRUCTURE.—The growth is a spheroidal-cell carcinoma of scirrhus type.

CLINICAL HISTORY.—The patient was a man who began to feel pain after food two years before the date of operation. When examined at the beginning of this period there was no free HCl or blood in the gastric contents, but occult blood was found in the stools. X-ray examination showed an irregularity in the pyloric antrum without delay in emptying of the stomach. After medical treatment the deformity of the pyloric region was less and the patient remained free from symptoms for over a year, gaining more than a stone in weight during that time.

The pain then recurred with gradually decreasing intervals of freedom and the patient began to lose weight. Further X-ray examination of the stomach showed a regular outline but a high grade of pyloric stenosis. All the specimens of a fractional test-meal contained blood. At no time was any tumour felt clinically.

At operation a growth of the lesser curvature near the pylorus, with many glands, was removed by partial gastrectomy.

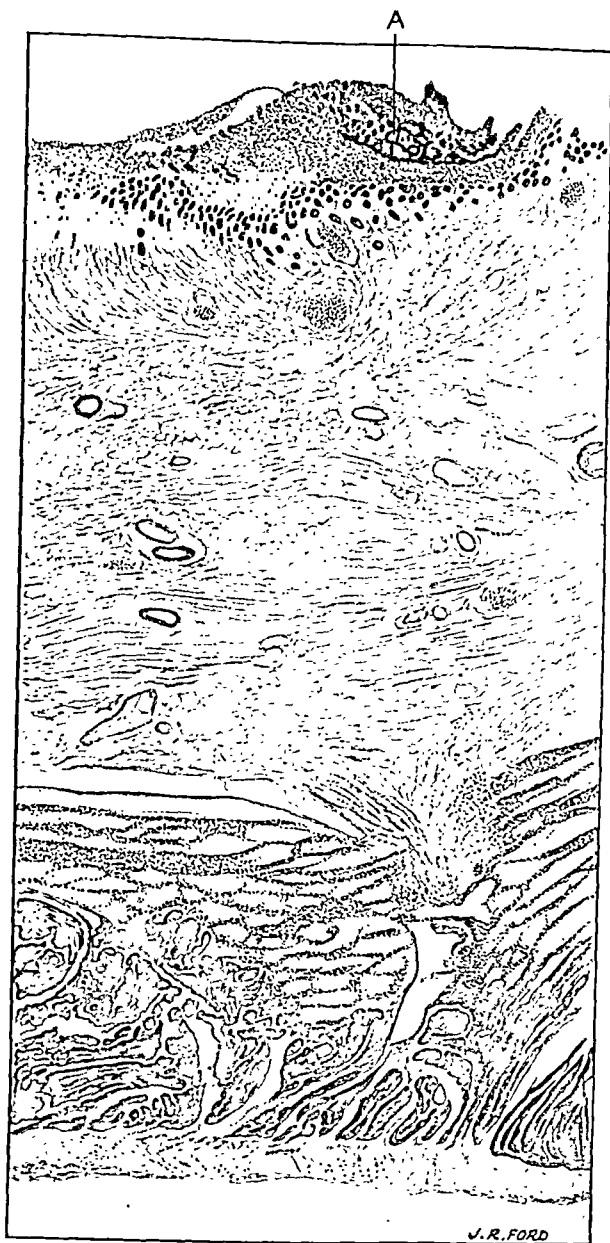


A more highly magnified view of the portion indicated by A in the microphotograph on p. 126. ($\times 200$.)

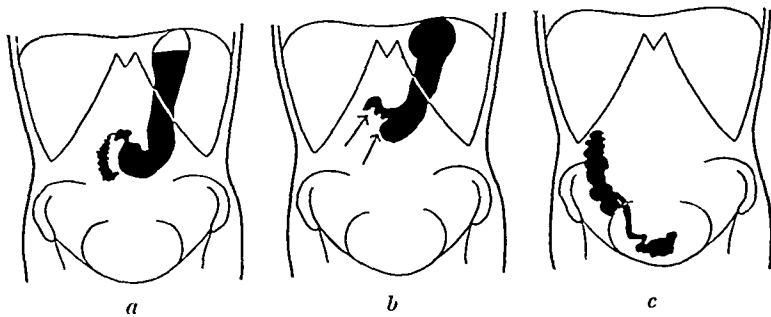
PATHOLOGICAL MUSEUM, LEEDS SCHOOL OF MEDICINE. E.220.E

NO. 6.—SUPPLEMENT

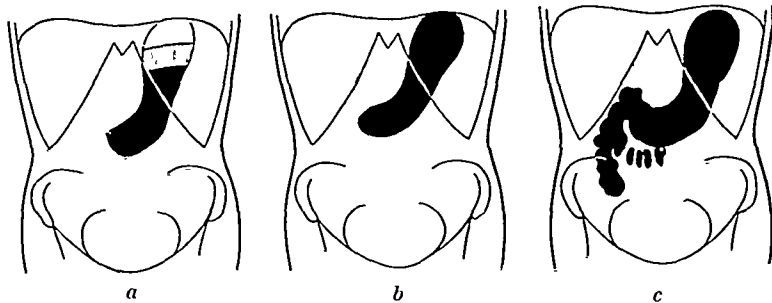
F 1



A, Portion shown, more highly magnified, on p. 125. ($\times 12$.)



Opaque meal shows constricted pyloric vestibule, but no delay in emptying. *a*, During meal, vertical; *b*, During meal, horizontal; *c*, After 4 hours.



Twenty-one months later. The shape of the stomach is regular, but there is a high degree of pyloric obstruction. *a*, During meal, vertical; *b*, During meal, horizontal; *c*, After 48 hours.

CARCINOMA OF STOMACH.

The pyloric half of a stomach, opened and showing the mucous surface.

An ulcerated carcinoma occupies the posterior wall and lesser curvature. It measures 4×3 in. in diameter, and has a raised margin which is both excavated and overhanging. The muscular coat is invaded but not breached.

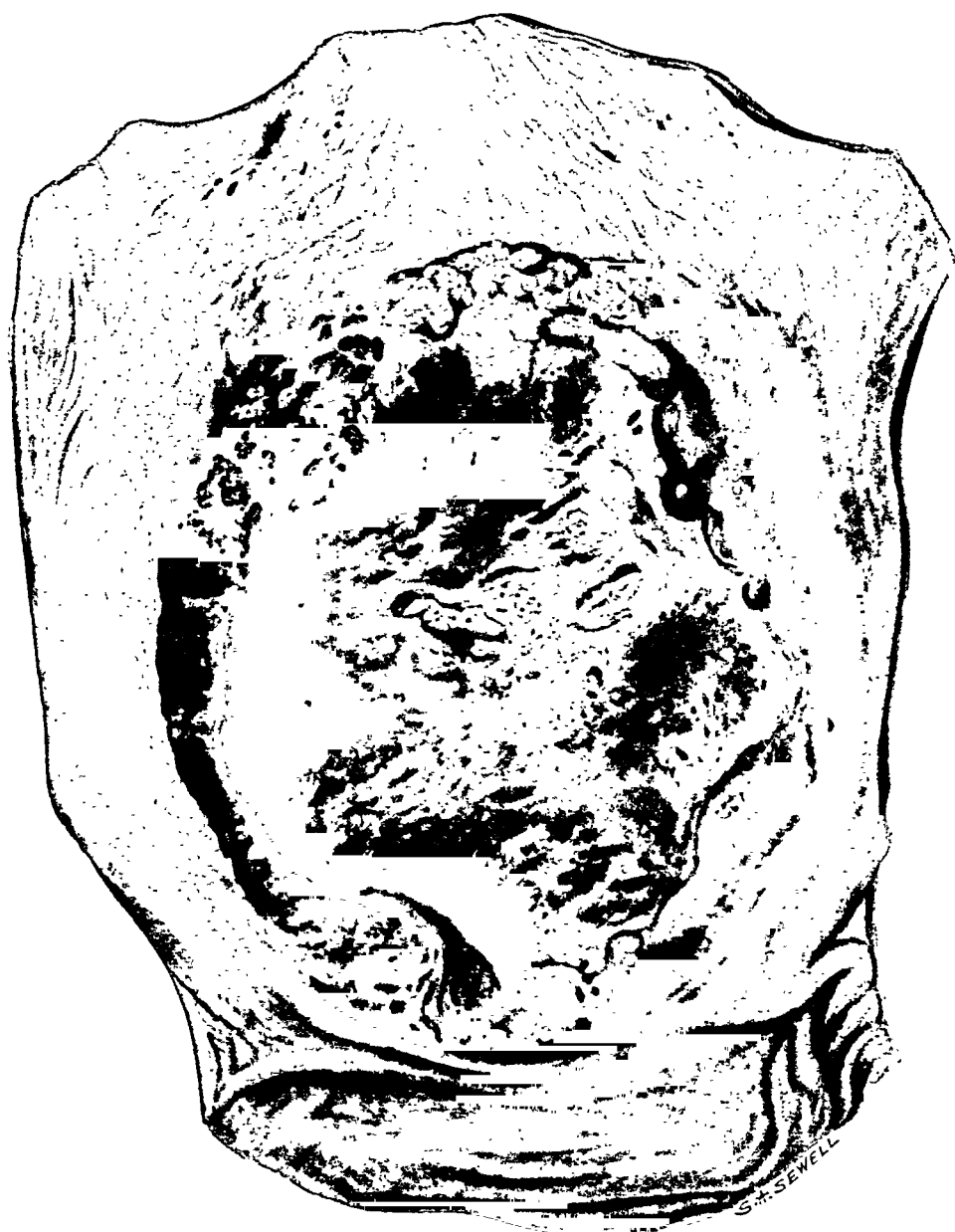
Pathological Museum, Leeds School of Medicine, E.220.C

MICROSCOPIC STRUCTURE.—The growth is a very cellular and active adenocarcinoma.

CLINICAL HISTORY.—The patient was a woman, aged 50, who for six months before admission to hospital had noticed that her clothes were becoming tighter round the upper part of the abdomen. After each meal she felt a sensation of fullness, but had had no pain or vomiting. For the last two months she had spent most of her time in bed, but had not lost weight.

On inspection, the whole abdomen was abnormally full. No peristalsis was seen. On palpation, a hard mass was felt in the right hypochondrium, extending into the epigastric and right lumbar regions. X-ray examination showed a filling defect in the pyloric half of the stomach, with delay in emptying. A fractional test-meal gave no free HCl and a total acidity slightly above normal. Bile was present.

At operation a growth of the pyloric end of the stomach the size of a cricket ball was removed by partial gastrectomy.



PATHOLOGICAL MUSEUM, LEEDS SCHOOL OF MEDICINE, E 220.C

POLYPUS OF STOMACH WITH CARCINOMA.

A stomach in two portions, opened and showing the mucous surface.

E. 220. F.—The pyloric half has been opened along the lesser curvature. A large, pedunculated polyp with a lobulated bulbous end is attached to the greater curvature $3\frac{1}{2}$ in. from the pylorus. Numerous small, sessile polyps are present on its cardiac side.

E. 220. G.—The cardiac half of the stomach has attached to it a portion of the œsophagus and the loop of the jejunum concerned in a gastrojejunosomy. On the posterior wall, just below the œsophageal orifice, is an oval, ulcerated carcinoma measuring 2 in. in its long diameter. Its margins are raised, rounded, and everted, and there is considerable sloughing in the centre.

Pathological Museum, Leeds School of Medicine, E.220.F. and G

MICROSCOPIC STRUCTURE.—A section of one of the smaller polyps shows a simple adenomatous overgrowth of the mucous membrane. A lymphatic gland from the neighbourhood of the cardia contains spheroidal-cell carcinoma.

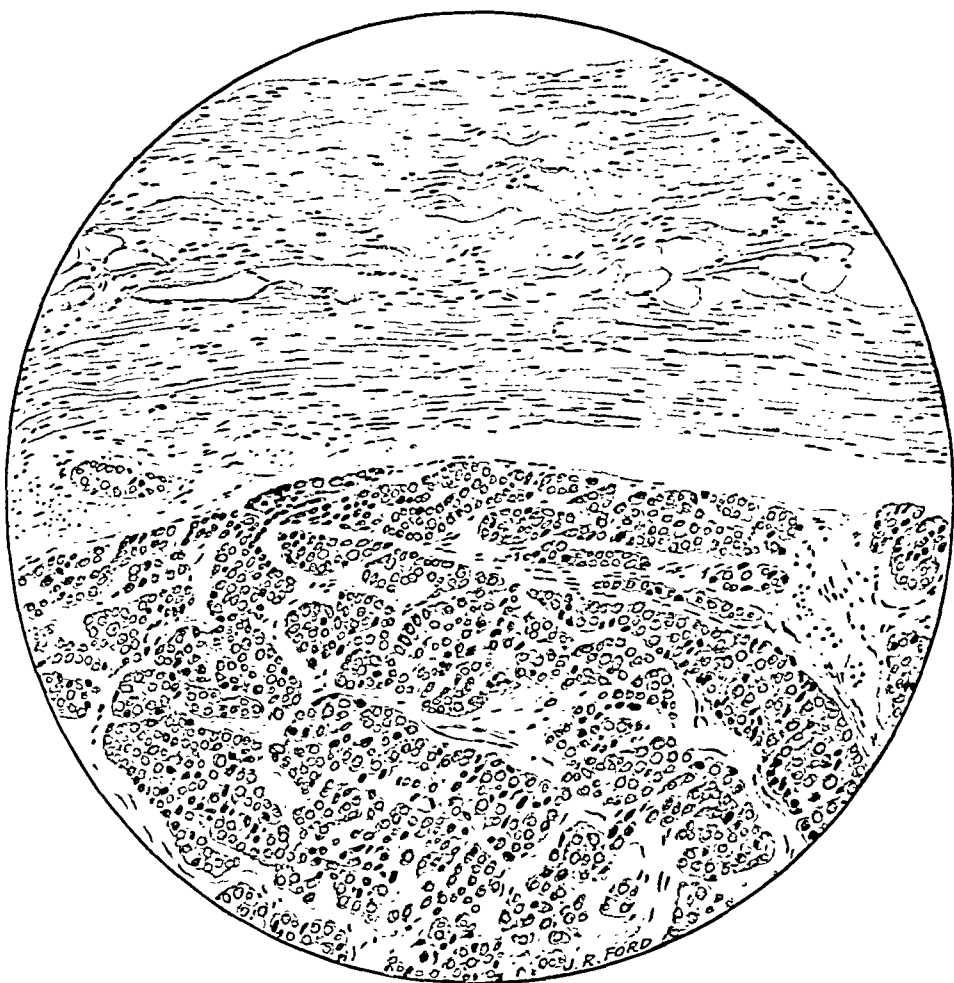
CLINICAL HISTORY.—The patient was a woman, aged 62, who had suffered from constant pain in the umbilical region for nine months before admission to hospital. In the early part of this period she had passed blood by the bowel, but she had never vomited blood. She had lost weight and was always constipated.

On examination of the abdomen there was tenderness and rigidity below the right costal margin. X-ray examination was rendered impossible by vomiting.

At operation, a polyp, $1\frac{1}{2}$ in. in diameter, growing from the lesser curvature, was removed by partial gastrectomy.

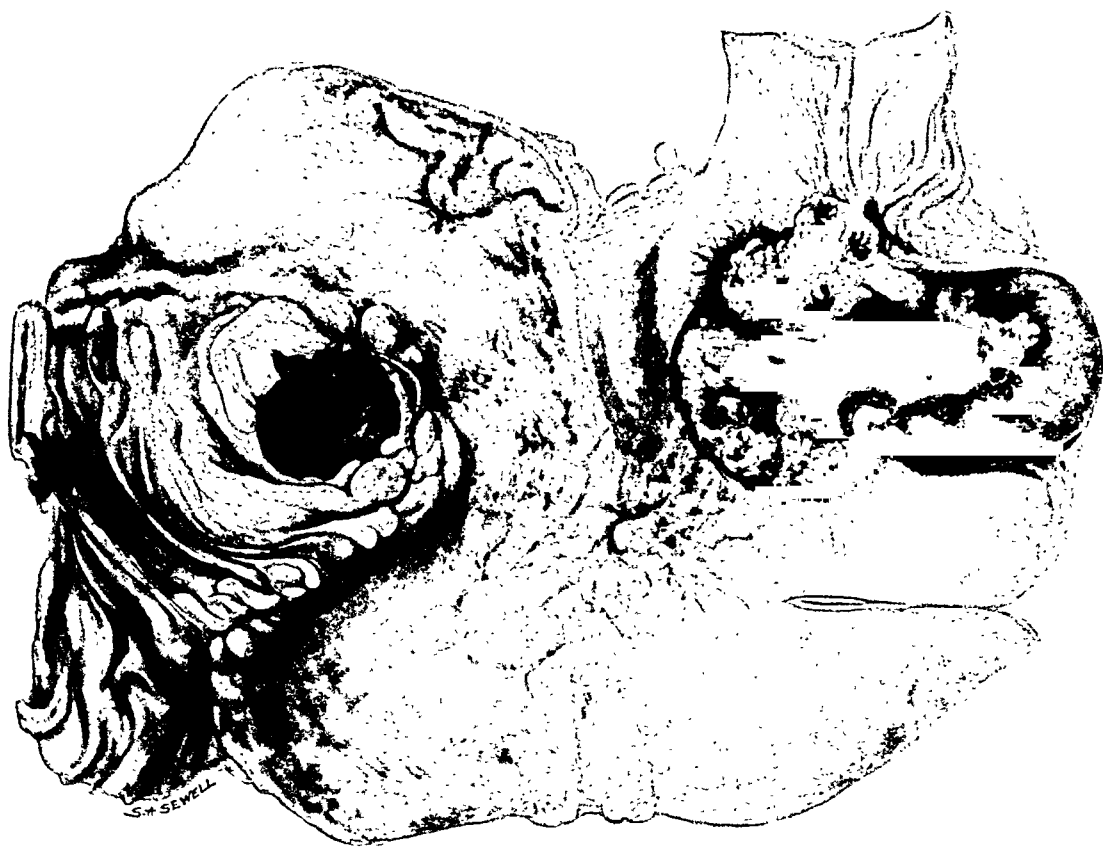
The patient died within one year of the commencement of her illness.

AUTOPSY.—Carcinoma of cardiac end of stomach involving œsophageal orifice. Multiple secondary deposits in liver and in glands around lower end of œsophagus and lesser curvature.



Microscopic section of lymphatic gland. ($\times 200$.)

PATHOLOGICAL MUSEUM, LEEDS SCHOOL OF MEDICINE, E.220.G



PATHOLOGICAL MUSEUM LEEDS SCHOOL OF MEDICINE, E.220.G

CARCINOMA OF STOMACH.

Part of a stomach, opened and seen from the mucous surface.

An ulcerated carcinoma, with a raised, everted edge and an irregular floor, is situated on the anterior wall of the stomach in its middle third.

A section through the centre of the lesion is also shown. The tumour has extended throughout the whole thickness of the stomach wall, and there is a deep, crateriform ulcer excentrically situated. At each end of the tumour the muscular coat of the tumour thins out on the peritoneal aspect.

Pathological Museum, Leeds School of Medicine, E.220.H

MICROSCOPIC STRUCTURE.—The tumour is a very cellular, actively proliferating adeno-carcinoma.

CLINICAL HISTORY.—The patient was a man who complained that for three months he had suffered from flatulence and discomfort soon after food and had tired rather easily. He had lost 7 lb. in two months.

X-ray examination showed a filling defect in the middle third of the stomach.

The specimen illustrated was removed by operation.



x 45

PATHOLOGICAL MUSEUM, LEEDS SCHOOL OF MEDICINE, E.220.H





PATHOLOGICAL MUSEUM, LEEDS SCHOOL OF MEDICINE E.220.H

SARCOMA OF STOMACH.

The pyloric end of a stomach from which the posterior wall has been removed.

A sarcomatous polypus, which is about the size of a duck's egg and slightly pedunculated, springs from the anterior wall of the stomach, and is rather nearer the greater than the lesser curvature. It is covered by mucosa which is intact except for two small areas of ulceration.

On section, the tumour is seen to be situated in the submucosa, and it does not appear to infiltrate either the mucous membrane or the muscular coat. The cut surface shows areas of mucoid degeneration in the solid tumour.

Pathological Museum, Leeds School of Medicine, E.228.A

MICROSCOPIC STRUCTURE.—The tumour is a mixed-cell sarcoma, with mucoid and cystic degeneration in parts.

CLINICAL HISTORY.—The patient was a man, aged 35, who complained of persistent vomiting, with little pain, for six years. Six weeks before admission to hospital he vomited "about 3 pints" of blood. On admission the blood-count showed: red cells, 3,300,000; hæmoglobin, 25 per cent; white cells, 12,800 (increase due to polymorphs).

No X-ray examination.

At operation, partial gastrectomy was performed. On opening the stomach, a tumour covered with normal but smooth mucous membrane was found. In the mucous membrane were two small holes, probably the site of the hæmorrhage.

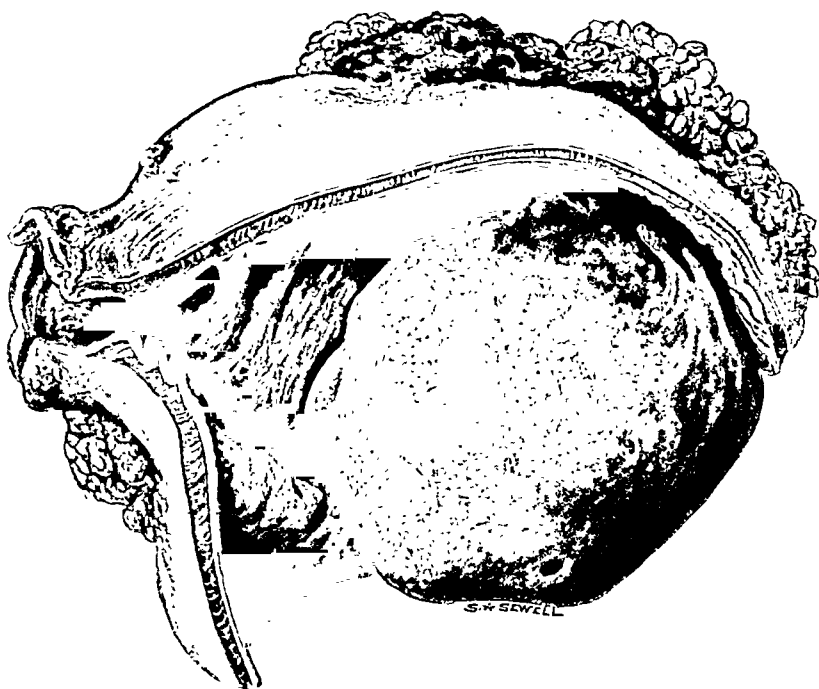


x 50

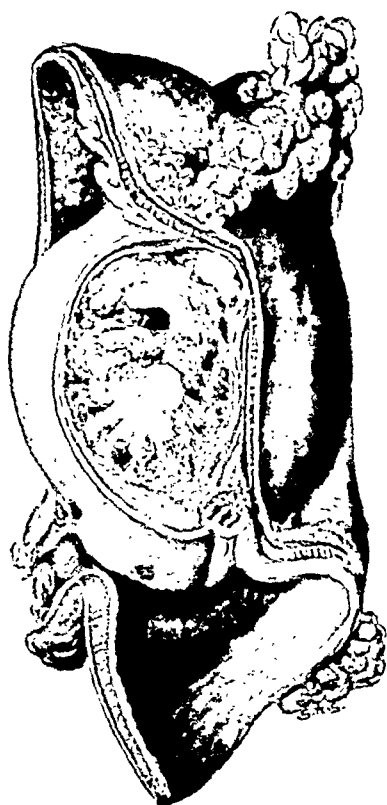


x 300

PATHOLOGICAL MUSEUM, LEEDS SCHOOL OF MEDICINE, E.228.A



SURFACE VIEW.



SECTION.

COLLOID CARCINOMA OF STOMACH.

A stomach from which a portion of the anterior wall has been removed.

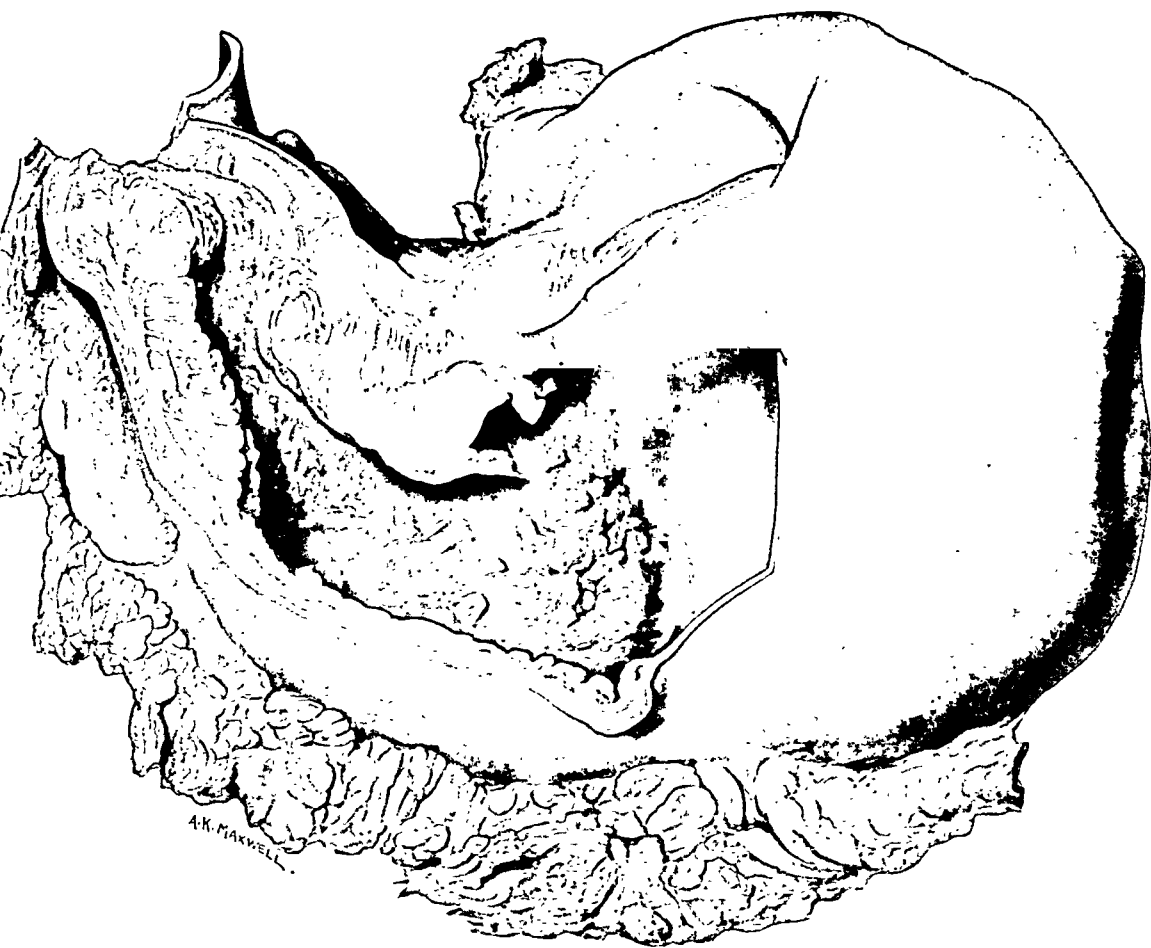
The pyloric half of the stomach is occupied by a nodular, translucent tumour which has infiltrated the whole length of the lesser curvature and has reduced the lumen of the pyloric canal to a narrow and tortuous slit. The fundus is free from growth.

Museum of St. Bartholomew's Hospital, 1936

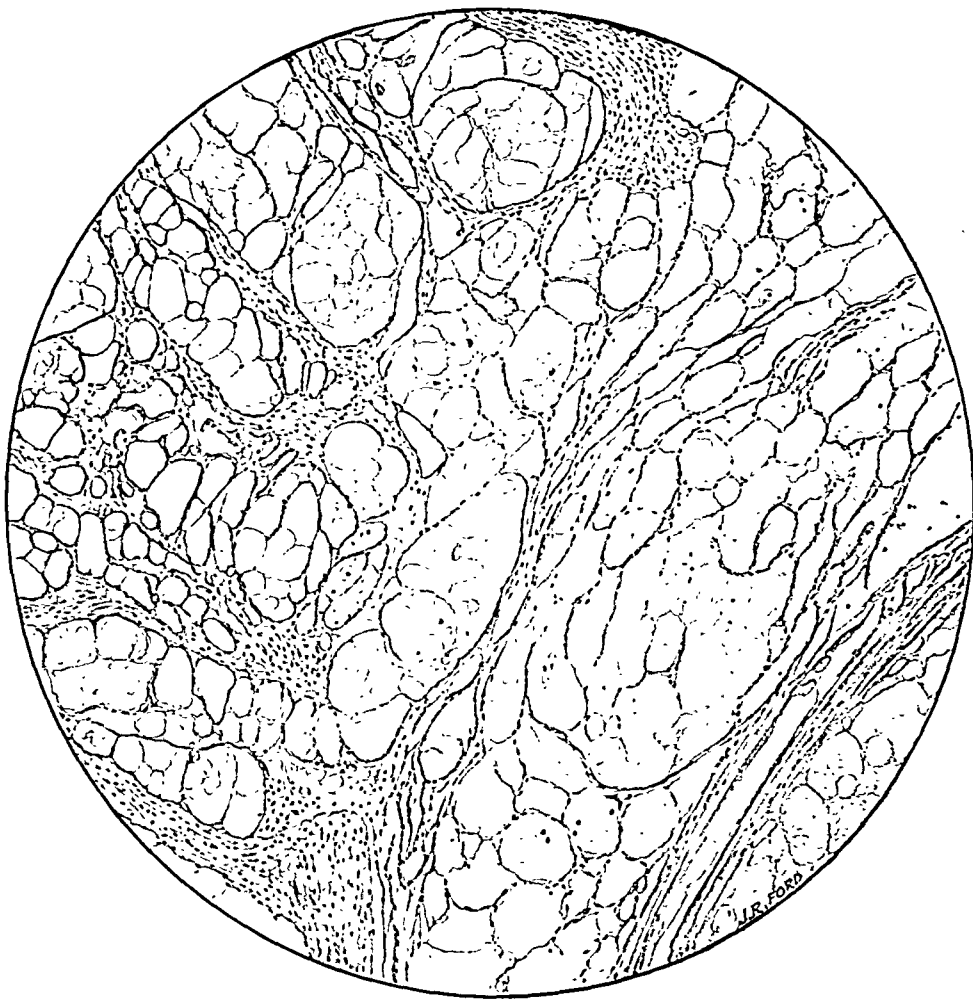
MICROSCOPIC STRUCTURE.—Spheroidal-celled carcinoma undergoing colloid degeneration.

CLINICAL HISTORY.—The patient was a man, aged 23, who for nine months had suffered from pain and vomiting after food. He had lost 3 stone in weight. He died of cachexia soon after an exploration at which the growth was found to be inoperable.

AUTOPSY.—The glands and great omentum were involved and the growth had reached the transverse colon.



MUSEUM OF ST. BARTHOLOMEW'S HOSPITAL, 1936



× 100

CARCINOMA OF STOMACH.

(‘LEATHER-BOTTLE’ TYPE.)

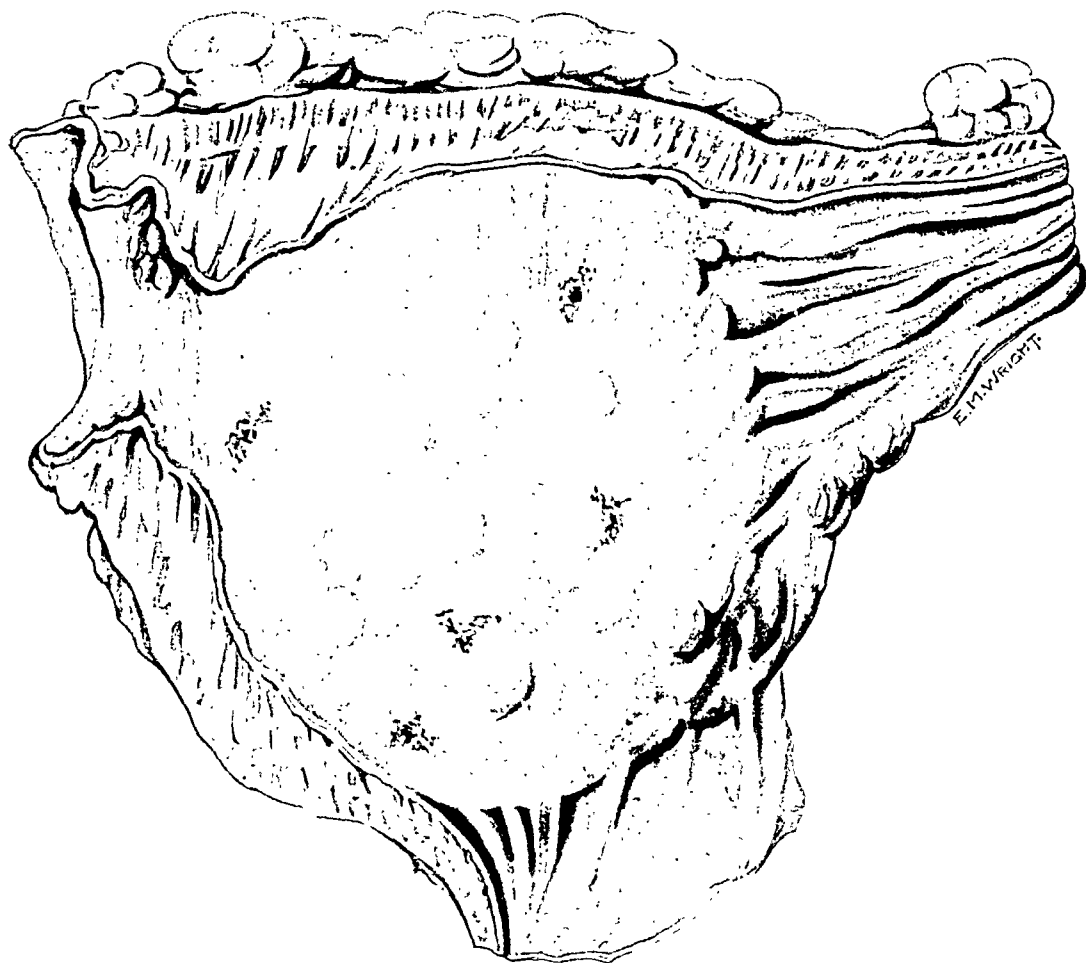
The pyloric half of a stomach, with the first part of the duodenum, opened, and drawn from the mucous surface.

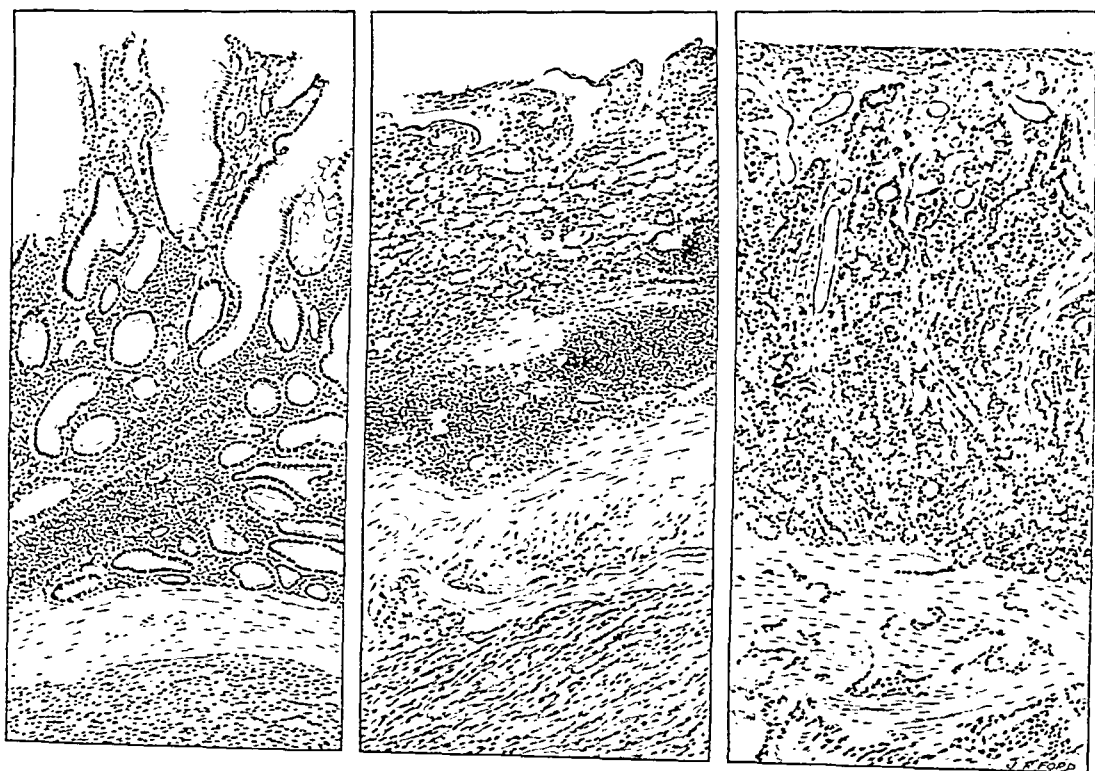
The whole circumference of the pyloric half of the stomach is thickened by a nodular growth over which the mucosa is intact. The carcinoma stops short at the pylorus, and is well defined along its cardiac border. The sub-mucosa is thickened by dense, white, fibrous tissue, strands of which invade the hypertrophied muscular coat.

Pathological Museum, Leeds School of Medicine, E.202.B

CLINICAL HISTORY.—The patient was a woman, aged 45, who was in good health until three years before admission to hospital. She then began to have bilious attacks two or three times a day, each attack lasting half an hour. She did not vomit until three months before admission, when she ceased to retain solid food. The pain was then of a dull aching character and lasted for an hour after a meal.

On admission to hospital a tumour was felt in the region of the stomach. X-ray examination showed a filling defect extending 3 in. along both curvatures from the pylorus, with a large residue after six hours. A fractional test-meal gave no free HCl and a very low total acidity curve with excess of mucus. At operation a thick-walled, leather-bottle stomach was exposed to a heavy dose of X rays. Partial gastrectomy was performed six weeks later. The lymphatic glands of the lesser curvature were involved.





× 85

MICROSCOPIC STRUCTURE.—The tumour is a densely fibrous, spheroidal-cell carcinoma, involving the mucosa and submucosa, and sending fine prolongations of fibrous and cancerous tissue into the muscular coat.

Pathological Museum, Leeds School of Medicine, E.202.B

CARCINOMA OF STOMACH.

Two transverse sections of the pyloric end of a stomach.

In one section the growth involves two-thirds, in the other three-fourths, of the circumference. The submucosa is irregularly thickened and the inner muscular coat is extensively invaded. The tumour extends upwards into the gastro-hepatic omentum.

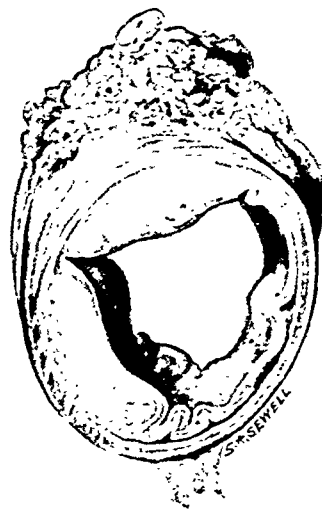
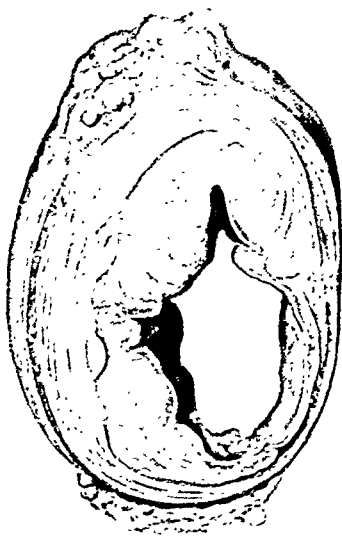
Pathological Museum, Leeds School of Medicine, E.220.D

MICROSCOPIC STRUCTURE.—Spheroidal-cell carcinoma of scirrhus type.

CLINICAL HISTORY.—The patient was a man, aged 55. Some years before he came under observation he suffered from vague indigestion and pain in the loins, but made a good recovery. He remained well until a few months ago, when he began to have discomfort and flatulence after food. There was no severe pain nor any vomiting, but much loss of weight and loss of appetite.

On examination of the abdomen a hard, movable lump the size of the thumb was felt at the level of the umbilicus.

At operation a growth was found in the pyloric half of the stomach, encircling about three-fourths of its circumference, and infiltrating extensively the lesser curvature and gastro-hepatic omentum. It was excised, together with a number of invaded glands along both curvatures.



PATHOLOGICAL MUSEUM, LEEDS SCHOOL OF MEDICINE. E.220 D

NO. 7—SUPPLEMENT

G1

CARCINOMA OF STOMACH.

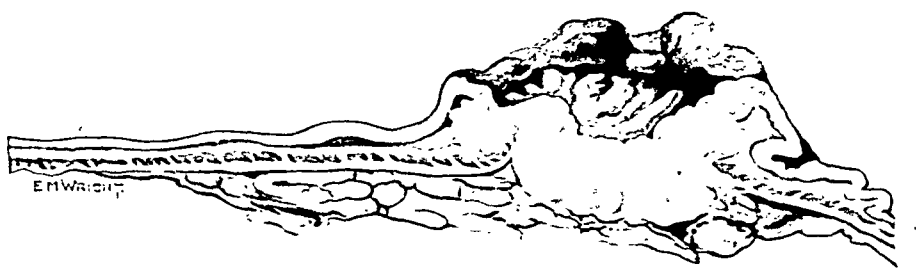
(SUPERVENING ON SIMPLE CHRONIC ULCER.)

A section from the wall of a stomach showing an ulcer carcinoma of the greater curvature.

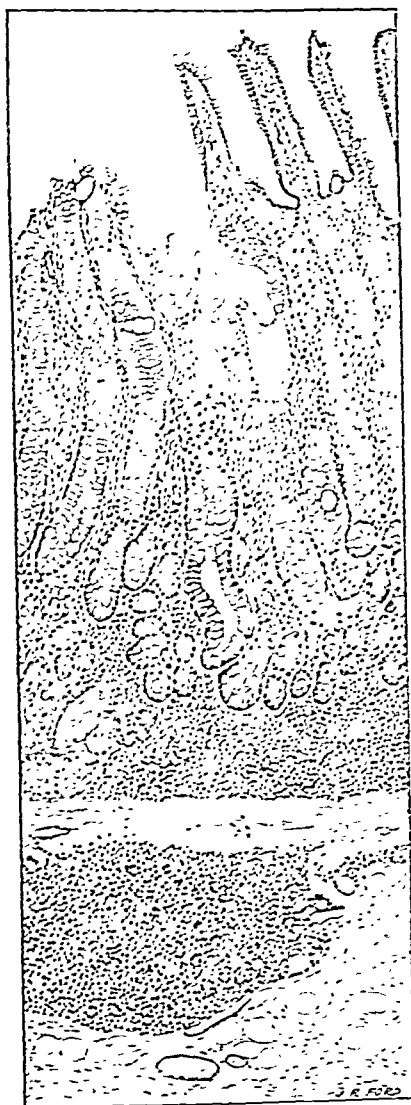
The lesion, which is situated $4\frac{1}{2}$ in. from the pylorus, is an obviously malignant, crateriform ulcer. The centre of the floor, however, shows the structure of a simple chronic ulcer, and there is complete absence of muscular tissue. The muscular coat turns up into the floor of the ulcer instead of thinning out on the peritoneal aspect. On these grounds the lesion is regarded as a primary chronic ulcer with secondary malignancy (Stewart, *Jour. Pathol. and Bacteriol.*, 1926, xxix, 321).

Pathological Museum, Leeds School of Medicine, E.208.B

CLINICAL HISTORY.—The patient was a man, aged 51, who had suffered from epigastric pain for two years. The pain commenced immediately after food and lasted for about an hour. At first it was intermittent, the longest interval of freedom being three weeks, but for the last four months before admission to hospital it was continuous and increasingly severe. He had lost $1\frac{1}{2}$ stone in weight.



PATHOLOGICAL MUSEUM, LEEDS SCHOOL OF MEDICINE, E.208.B



× 60

MICROSCOPIC STRUCTURE.—Adeno-carcinoma.

Pathological Museum, Leeds School of Medicine, E.208.B

VI. GASTRIC AND DUODENAL ULCER.

SIMPLE ulceration along the lesser curvature of the stomach and in the first part of the duodenum is a common disease. It is usual for the ulcers either to show a strong tendency towards spontaneous healing within a few weeks, or to persist indefinitely for years. They are therefore classified as acute and chronic.

ACUTE GASTRIC ULCER.—Acute ulcers are multiple and are often scattered irregularly over the whole service of the mucosa, though they are more common along the lesser curvature and in the pyloric half of the stomach. They occur at an earlier age than does the chronic ulcer, the majority of the patients being between 15 and 30. They produce symptoms more often and are probably more common in women than in men.

The immediate cause of acute ulcer is the digestion of a damaged area of mucous membrane by the gastric juice. In many cases the nature of the damage to the mucosa can be recognized, and is either a hæmorrhage ('hæmorrhagic erosion'), a patch of necrosis, or the inflammation of a lymphoid follicle ('follicular ulcer'). In other cases there is no recognizable antecedent damage to the mucosa, and in these the ulcer may show a greater tendency to progress towards the chronic variety.

Infection is one of the main factors in the devitalization of the mucosa which predisposes to the formation of acute ulcers. This is shown by the frequency with which they occur in association with oral sepsis, appendicitis, suppurating wounds, burns, septicæmia, etc. They appear also in connection with chronic nephritis and with the venous congestion of a failing heart.

An acute ulcer is round or oval in shape, with sharply-cut edges which are not raised above the surrounding surface. Its floor is at first formed by the submucosa. This layer is then destroyed, over an area which is excentrically situated and smaller than that of the breach in the mucosa, and is converted into a blood-stained slough which covers the floor of the ulcer. When the slough separates, the fibres of the muscular coat are exposed, and the edges of the gap in the submucosa are sharply-cut. The perpendicular drop from mucous surface to submucosa and from submucosa to muscularis produces the stepped or 'terraced' appearance so characteristic of the deeper forms of ulcer.

With the destruction of the submucosa and the exposure of the muscularis the ulcerative process usually ceases. Should further digestion occur, the muscular coat may be partly or wholly penetrated, but the peritoneal coat is so little affected that the existence of an acute ulcer can rarely be detected by examination of the stomach from the outside. Perforation of an acute ulcer is a rare phenomenon. Hæmorrhage, on the other hand, is common, because the vessels of the submucosa are eroded before their lumen has been reduced by inflammatory thickening of their walls or obliterated by thrombosis.

The histological appearance of an acute ulcer is characterized by an absence of signs of inflammatory reaction other than œdema. The mucous membrane is healthy up to the edge of the ulcer, the submucosa is not thickened by fibrosis, and the floor is composed of muscle without any covering of granulation tissue. The mouths of eroded vessels are sealed by clot.

Acute ulcers, if superficial, heal by the spread of epithelium from the edges over the surface of the submucosa. Glands are formed by downgrowths from the deep surface of this epithelium, and a mucous membrane of approximately normal structure is thus re-formed. Provided that the muscularis has not been destroyed there is no scar to mark the site of the ulcer, but any breach of this coat is filled by fibrous tissue, the contraction of which produces a pucker in the wall of the stomach.

The healing of an acute ulcer is normally completed within a few weeks, but under certain conditions it may be so delayed that an ulcer assumes the characters associated with chronicity. The conditions under which this change takes place are not fully understood, but two factors certainly contribute towards it. These factors are delay in evacuation of the stomach contents through spasm or stenosis of the outlet, and increase in the acidity of the gastric juice.

CHRONIC GASTRIC ULCER.—Chronic gastric ulcers are usually situated in the pyloric half of the stomach either on the lesser curvature or on the posterior surface close to the lesser curvature. They scarcely ever lie exactly over the pyloric sphincter. As a rule the ulcer is single, though it may be accompanied by several superficial acute ulcers in its neighbourhood or by a duodenal ulcer. Men are affected more than twice as often as women. Symptoms of the disease begin to appear at any age after 20, and, unless the ulcer heals, usually reach an intensity which compels surgical treatment within 10 to 15 years of the onset.

The diameter of the crater of a chronic ulcer, as seen at operation, averages $\frac{1}{2}$ to $\frac{3}{4}$ in., although it may be considerably larger or smaller than this irrespective of the length of the clinical history. The apparent size is conditioned to a great extent by contraction of the muscular coat, and specimens obtained at autopsy therefore appear larger than those which are observed during life. The most common shape is round, and the chief variants of this are elongated either along the lesser curvature or across it. In the latter case—'saddle' ulcer—approximately symmetrical areas of the anterior and posterior surfaces are involved.

The appearance of a chronic ulcer depends in part upon the degree of activity of the ulcerative process. Thus, a given ulcer, the symptoms of which have extended over several years, may be spreading, stationary, or healing at the time of examination, and will present characters which accord with its state.

A chronic ulcer in a quiescent condition has a border which is smooth, rounded, and slightly raised above the surface of the surrounding mucosa. The mucous membrane extends to the edge of the crater, which has vertical sides and passes straight through the submucous and muscular coats to the thickened subperitoneal layer which forms its base. The sides and floor of this crater are lined by granulation tissue. On the peritoneal surface the

site of the ulcer is marked by œdematous thickening and congestion of the serosa, and, during life, by a bright red stippling of the surface corresponding to the margin of the crater. This stippling, which is accentuated by mechanical irritation, is due to newly-formed, thin-walled vessels in the inflammatory fibrous tissue. Fibrosis of the subperitoneal layer also shows through the œdematous serosa as an opaque, white area from which lines radiate out over the surrounding part of the stomach. The peritoneal surface is often adherent to neighbouring structures, such as omentum, liver, or pancreas—the adhesions varying from fibrinous deposits to dense fibrous tissue. When the omentum is adherent to the base of a chronic ulcer, it becomes thickened by œdema, fibrosis, and an extra deposit of fibrotic fat. If the pancreas is adherent to the base of an ulcer, a localized area of the gland becomes similarly indurated by œdema and fibrosis. The thickened wall of the stomach around the ulcer, together with the inflamed and adherent omentum, make up a palpable mass which is easily recognizable to the touch at an operation, and may even be large enough to be felt through the abdominal wall.

In a section through a chronic ulcer, the most characteristic changes are the complete destruction of the muscular coat, the fibrosis of the submucosa around the crater, and the inflammatory thickening of the subperitoneal tissue which forms the base. The mucous membrane, which is œdematous and congested where it passes over the rounded margin of the ulcer, ceases abruptly at the edge of the crater. The muscularis mucosæ often fuses with the muscular coat at the point where the two end, and both the submucous and subperitoneal layers are thickened by œdema, round-celled infiltration, and fibrosis, and contain numerous large vessels. The blood-vessels in the base and sides of a chronic ulcer show the usual thickening of the coats and narrowing of the lumen which obtains in chronic inflammatory lesions. The neighbouring lymphatic glands are enlarged by inflammation, but remain soft and pink.

If an ulcer is examined in one of its periodic phases of increased inflammatory activity, the surrounding œdema will be greater, and a crop of superficial, acute ulcers may appear on the mucous membrane in the neighbourhood. The points where ulceration is extending, whether laterally or through the floor, are marked by sloughs. If hæmorrhage has occurred, the eroded vessel can be seen projecting through the floor. Acute perforation into the general peritoneal cavity can only occur if the ulcer is on the anterior surface of the stomach. When the ulcer is on the posterior surface and perforation occurs, the small sac is usually obliterated by adhesions which encircle the area of perforation, and the net result is that the surface of the pancreas becomes the floor of the ulcer in place of the fibrosed subperitoneal tissue. Perforation of an ulcer of the lesser curvature into the gastrohepatic omentum may lead to the formation of a considerable cavity in the latter, with walls composed of fibrosed fat lined by granulation tissue. Ulcers which perforate the wall of the stomach, but remain adherent to some other structure which then forms their floor, are sometimes described as 'penetrating', to distinguish them from the 'perforating' ulcer of the anterior surface which causes acute, spreading peritonitis.

When a chronic ulcer of the anterior surface of the stomach perforates

acutely, the actual perforation is preceded by an exacerbation of the ulcerative process, which leads to the sloughing of a part of the base of the ulcer. The slough is then digested and the gastric contents escape. The peritoneal opening is considerably smaller than the diameter of the ulcer as seen from the mucous surface, its edges are thin, and it is surrounded by a ring of yellowish 'lymph'. The peritoneum around the margin of the perforation is congested and œdematous. Should the omentum be in the immediate neighbourhood, it may become adherent to the margins of the aperture after the first escape of stomach contents, but in no case is such an omental plug able permanently to withstand the digestive action of the gastric juice.

The first step towards healing of a chronic ulcer is the separation of sloughs. When this is complete and the granulation tissue is clean and healthy, the epithelium begins to grow over its surface from the edge of the mucous membrane. The crater is partially filled in by granulation tissue, and still further reduced in size by contraction of the fibrous tissue in its base and sides. In any stage short of complete healing, the ulcer, as seen from the mucous surface, has a shelving edge from which the epithelium can be seen spreading over the floor. At any moment this process may be arrested, and the edge then becomes undermined again where the ulcer is beginning to extend laterally. Such alternations of attempted healing and recrudescence of activity are more common than healing which progresses without interruption to completion.

When a chronic ulcer is entirely healed, the scar is depressed and smooth on the mucous side, and is surrounded by radiating folds of mucosa produced by the centripetal traction of the scar. On the peritoneal surface there is an opaque, white area of fibrosis corresponding to the site of the ulcer, with radiating lines running out over the surrounding surface, and, frequently, adhesions to neighbouring viscera. Around the scar the vessels are dilated. On section, the gap in the muscularis is filled by fibrous tissue, and the thickness of the mucous membrane, though variable, approximates to the normal.

The contraction of the inflammatory fibrous tissue of a chronic ulcer often leads to narrowing of the lumen of the stomach. The degree of stenosis is largely independent of the size of the ulcer, and the length of time which elapses between the appearance of the symptoms of ulceration and those of the resulting stenosis depends chiefly upon the area of cross-section of the stomach in the plane of the ulcer. Thus, an ulcer near the pylorus may produce pyloric stenosis in 2 or 3 years, whereas an ulcer in the middle of the lesser curvature may take 20 years to produce the characteristic 'hour-glass' deformity. 'Hour-glass' deformity is more often seen in women than in men, because ulcers situated high up on the lesser curvature are commoner in women. Contraction in the base of the ulcer draws the greater curvature up towards the lesser and produces the characteristic deformity. Pyloric stenosis often accompanies mediogastric stenosis, and is then due to the co-existence of a duodenal ulcer. Dilatation of the stomach and hypertrophy of its muscular coat follow obstruction to the passage of its contents.

DUODENAL ULCER.—Both acute and chronic ulcers occur in the duodenum as in the stomach, and are probably due to similar causes. Duodenal

ulcer appears to be specially connected with appendicitis, and its association with burns has long been noted.

Chronic duodenal ulcer is a common disease of men between the ages of 30 and 50. It is much less common in women. The ulcers are almost always confined to the first inch of the duodenum, and are usually situated definitely on the anterior or posterior walls, while in about 25 per cent of cases both anterior and posterior ulcers co-exist. Duodenal ulcers are, on the whole, considerably smaller than gastric ulcers, but present similar morphological characters. They are rather more common on the anterior than on the posterior surface, and therefore perforate more often into the peritoneal cavity than do gastric ulcers. Posterior duodenal ulcers produce an inflammatory mass in the pancreas, which they frequently erode, and, owing to the proximity of the superior pancreatico-gastric vessels, hæmorrhage is common.

Stenosis of the duodenum as the result of contraction of scar-tissue in an ulcer remote from the pylorus seldom reaches a high grade, but is often sufficient to produce slight dilatation of that part of the viscus which lies between the ulcer and the pylorus, and so to lead to the formation of a duodenal 'pouch'. 'Pyloric stenosis' is a common result of duodenal ulceration. It may be more accurately described as stenosis of that part of the duodenum which lies immediately distal to the pyloric ring.

GASTROJEJUNAL AND JEJUNAL ULCER.—Ulceration of the margin of the stoma or of the jejunum opposite or immediately distal to the anastomosis follows the operation of gastrojejunostomy in about 2 per cent of cases. Rarely the secondary ulcer is on the proximal side of the stoma. Symptoms usually appear within two years of operation. This type of ulcer is more common when the primary ulcer for which the gastrojejunostomy was performed was in the duodenum. Non-absorbable sutures employed in the gastrojejunostomy may, in some cases, play a part by keeping up local irritation, but the chief cause of gastrojejunal and jejunal ulceration is the contact of gastric juice of high acid content with the jejunal mucosa.

The morbid anatomy of gastrojejunal and jejunal ulcers is similar to that of gastric and duodenal ulcers. Contraction of scar-tissue leading to stenosis of the stoma is a common sequel. Perforation occurs into the abdominal wall after formation of adhesions, into the peritoneal cavity, and, occasionally, into the transverse colon, when a jejunocolic fistula becomes established. Severe hæmorrhage is rare.

ACUTE GASTRIC ULCERS.

Portions of a stomach and duodenum laid open, and drawn from the mucous surface.

A number of acute ulcers are scattered along the lesser curvature. In the middle of the series are several grey patches of necrotic mucous membrane which have not yet been digested. Below these is a large ulcer which has resulted from necrosis and digestion of the mucous and submucous coats. Its floor is formed by the circular fibres of the muscularis. The margins are, for the most part, sharply-cut, and remnants of necrotic tissue and blood-clot are adherent to them and to the floor. At the lower border of the ulcer lateral extension was proceeding at the time of death. The uppermost ulcer has penetrated the muscular coat, and its floor is formed by subperitoneal tissue. Its upper edge is undermined, and the ulcer is beginning to assume the characters of chronicity.

The mucous membrane of the stomach is thickened generally by chronic gastritis, and the muscular coat is moderately hypertrophied.

Museum of University College Hospital, 3045.B

CLINICAL HISTORY.—The patient was a woman, aged 65, who died from mitral stenosis and granular kidneys. No gastric symptoms or signs are noted in the clinical records.



MUSEUM OF UNIVERSITY COLLEGE HOSPITAL, 3045.B

ACUTE GASTRIC ULCERS.

Part of a stomach opened, and drawn from the mucous surface.

On the lesser curvature are several small, circular and oval, sharply defined ulcers; the largest is 1.5 cm. in its chief diameter, and has a blood-stained base.

Hunterian Museum, R.C.S. 675.1

CLINICAL HISTORY.—The patient was a woman, aged 53, who had suffered from attacks of appendicitis in July and November, 1909, and was admitted to hospital in January, 1910, with an acute attack of that disease. Death occurred after operation.

AUTOPSY.—Purulent peritonitis was found to have followed perforation of the appendix; cystitis was also present.



A. K. MAXWELL

HUNTERIAN MUSEUM, R.C.S. 675.1

SUBACUTE GASTRIC ULCERS.

A portion of the pyloric end of the stomach, together with the pylorus and the first inch of the duodenum, opened and spread out flat.

The main ulcer, which is situated on the lesser curvature and reaches to within $\frac{1}{2}$ in. of the pylorus, has invaded but has not completely penetrated the muscular coat. Its hard, raised margins are slightly excavated. An inch higher up on the lesser curvature is a second ulcer, almost healed.

Pathological Museum, Leeds School of Medicine, E.166

CLINICAL HISTORY.—The patient, a man, aged 50, died of carcinoma of the œsophagus. The notes make no reference to gastric symptoms.



PATHOLOGICAL MUSEUM, LEEDS SCHOOL OF MEDICINE, E.166

CHRONIC GASTRIC ULCER.

The anterior half of the pyloric end of a stomach.

A chronic ulcer is situated on the small curvature immediately proximal to the pylorus, and extends to the anterior surface for a distance of nearly an inch ; it is about $\frac{3}{8}$ in. in width, and has perforated the muscular coat, its base being formed by the thickened small omentum. The muscle of the pyloric ring is much hypertrophied, but the pyloric orifice does not appear to have been constricted. The stomach wall generally is stiff from hypertrophy of its muscular layer. Externally there are a few adhesions in the situation of the ulcer, but no other deformity. There are no enlarged glands.

Hunterian Museum, R.C.S. 2402.G

MICROSCOPICAL STRUCTURE.—Simple chronic ulcer.

CLINICAL HISTORY.—The patient was a man, aged 52, who had suffered from indigestion for ten years. He was much wasted, and the stomach was greatly dilated, a barium meal demonstrating a large residue after twenty-four hours.



HUNTERIAN MUSEUM, R.C.S. 2402.G

CHRONIC GASTRIC ULCER.
(THROMBOSIS OF SPLENIC ARTERY.)

Portions of the stomach, pancreas, and spleen.

On the posterior surface of the stomach is a circular chronic ulcer, the base of which is formed by the pancreas and splenic vessels. The splenic artery is occluded by firm clot for the greater part of its length. The cut surface of the spleen shows numerous infarcts, and its convex surface is adherent to the diaphragm.

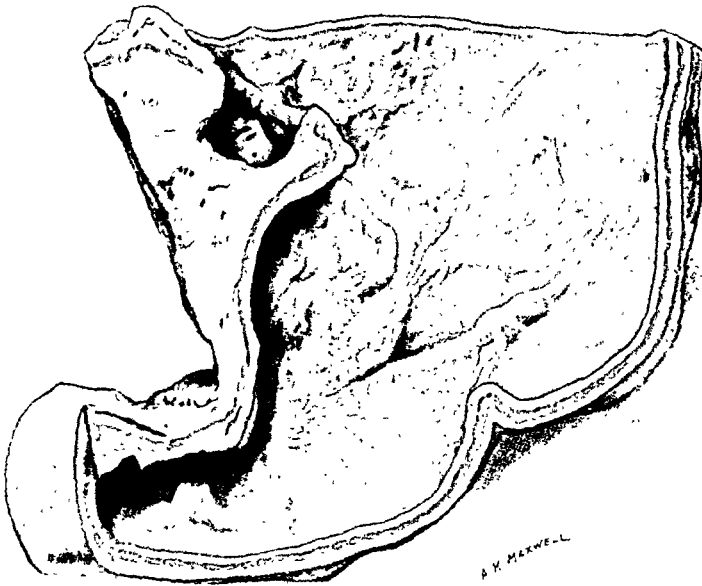
Museum of St. Bartholomew's Hospital, 1914.C

CLINICAL HISTORY.—The patient was a woman, aged 38, who had had epigastric pain relieved by vomiting for two months. On the day after admission to hospital the vomiting became much worse, but there was no hæmatemesis. A left pleural effusion was present. Three days later she began to pass blood by the bowel. Pain and melæna continued until her sudden death two weeks afterwards.



MUSEUM OF ST. BARTHOLOMEW'S HOSPITAL, 1914.C

CHRONIC GASTRIC ULCER.



The pyloric portion of a stomach with the first part of the duodenum in section.

On the lesser curvature of the stomach and involving the pylorus is an irregularly oval, chronic ulcer which has penetrated the muscular coat and has produced a deep pit in the sclerosed subjacent tissues.

Hunterian Museum, R.C.S. 676.2

CLINICAL HISTORY.—The patient was a man, aged 48, who suffered from dyspepsia.

DUODENAL ULCER.

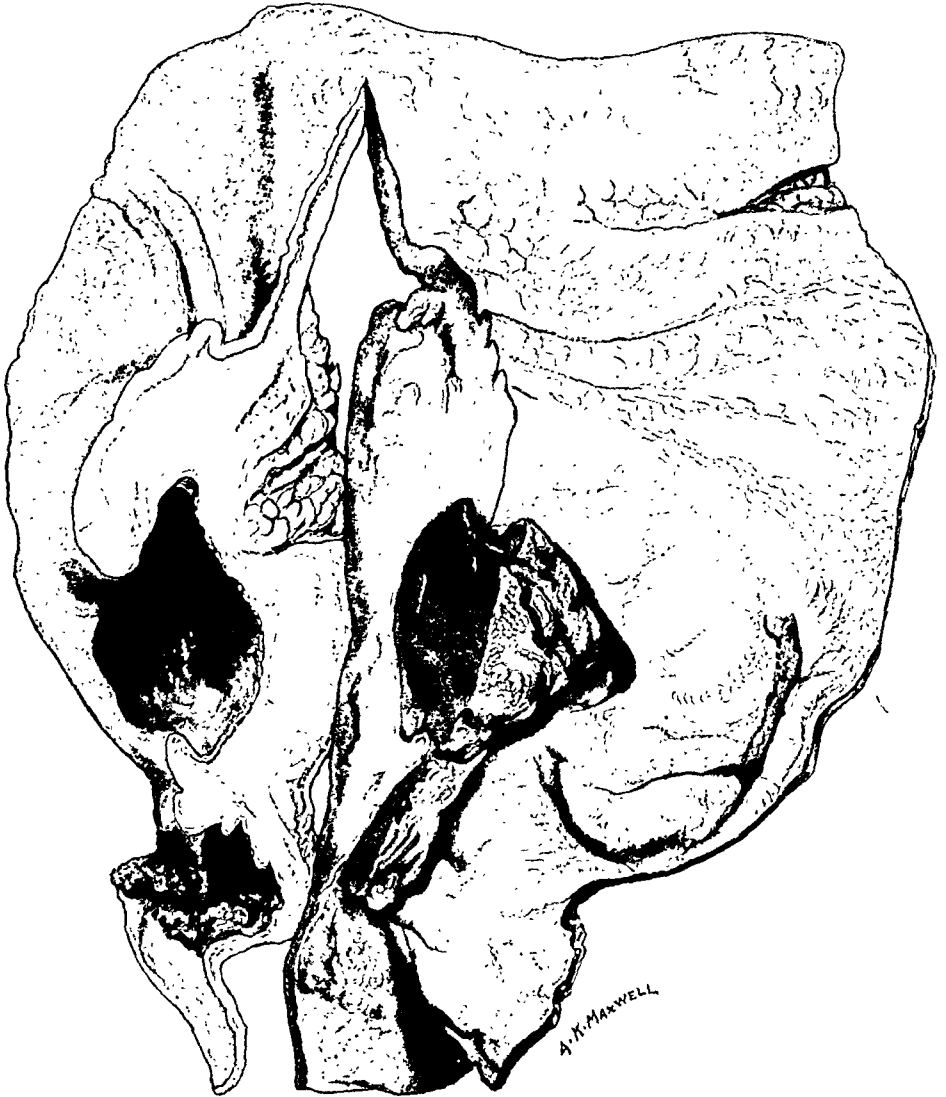
The first 2 inches of the duodenum and a portion of the stomach divided longitudinally. In the first part of the duodenum is a chronic ulcer which has eroded the pancreas and has undermined the pyloric sphincter on the gastric side. The deep crater of the ulcer contained blood-clot, which has been removed from one half of the specimen. The mucous membrane of the duodenum on the distal side of the ulcer is stained with blood.

Museum of University College Hospital, 13554

CLINICAL HISTORY.—The patient was a man, aged 70, who had suffered from epigastric pain and loss of appetite for six weeks. The pain was not related to the taking of food. He had vomited small quantities of clear fluid about two hours after his meals, and had lost 2 stone in weight. One week before admission to hospital he had brought up about 5 oz. of dark-red blood.

On admission he was wasted and pale, the blood containing 38 per cent of hæmoglobin. On examination there was slight tenderness to the left of the middle line just below the costal margin. No mass was felt. On the fifth day after admission he became much paler, brought up 2 pints of altered blood, and died within a few hours.

AUTOPSY.—The stomach and both small and large intestines contained blood throughout their whole length. There was a deep, chronic ulcer encircling the posterior, upper, and part of the anterior walls of the first part of the duodenum, which was closely adherent to the liver and pancreas.





MUSEUM OF UNIVERSITY COLLEGE HOSPITAL, 13554

CHRONIC GASTRIC ULCER.

(HÆMORRHAGE.)

A stomach opened along the greater curvature.

A chronic ulcer is situated about the middle of the posterior surface, and extends from the lesser almost down to the greater curvature, where it has produced an 'hour-glass' deformity. Its margins are smooth, firm, and undermined. Its floor is formed by the pancreas, to which the posterior surface of the stomach is firmly adherent. In the upper part of the floor is an eroded opening into a large artery.

Manchester Royal Infirmary, 43

MICROSCOPIC STRUCTURE.—Simple, chronic ulcer.

CLINICAL HISTORY.—The patient was a thin woman, aged 43, who had had indigestion almost all her life. Her symptoms became much worse during the last three months of her life. She complained of pain which commenced from half an hour to three hours after food, and was relieved by taking food or by vomiting. There was a history of hæmatemesis twenty years before, but this did not recur until the severe hæmorrhage which occupied the nineteen hours preceding death. The pain was felt below the left costal margin, where there was a palpable mass.

AUTOPSY.—Both the cardiac and pyloric pouches of the stomach were full of blood-clot, and blood was present throughout the upper two-thirds of the small intestine. The mouth of the eroded artery was partly filled by friable and easily-detached red blood-clot.



MANCHESTER ROYAL INFIRMARY, 43

NO. 8.—SUPPLEMENT

111

GASTRIC ULCER.

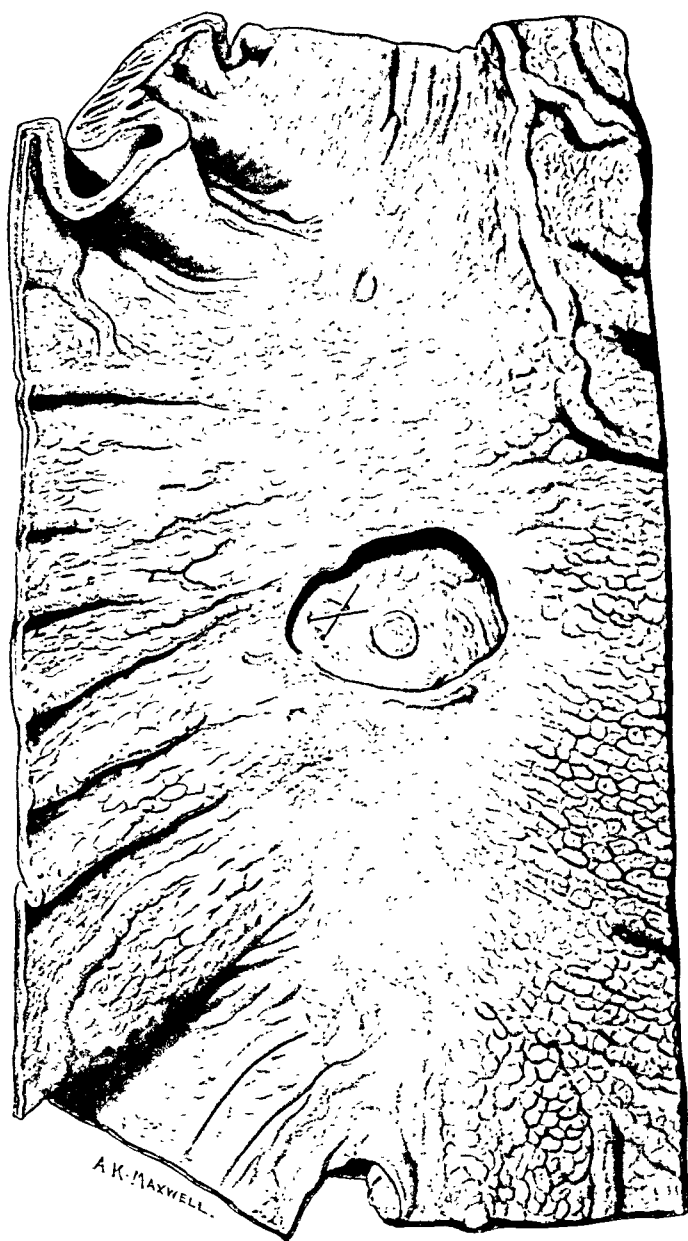
(HÆMORRHAGE.)

Part of a stomach, opened, and drawn from the mucous surface.

On the lesser curvature is a sharply defined, almost circular ulcer, about 2.5 cm. in chief diameter, with slightly overhanging edges. In the recent state a small aneurysm of the coronary artery was seen in the base. Two of the branches of the vessel which were ulcerated are indicated by glass rods. Nearer the pylorus than the ulcer shown, there is a small subacute erosion on the lesser curvature.

Hunterian Museum, R.C.S. 676.1

CLINICAL HISTORY.—The patient was a man, aged 41. Five weeks before death he complained of pain after food, and on two occasions vomited blood. In spite of treatment, hæmatemesis, accompanied by mælena, recurred, and proved fatal.



HUNTERIAN MUSEUM, R.C.S. 676.1

RUPTURED ŒSOPHAGEAL VARIX.

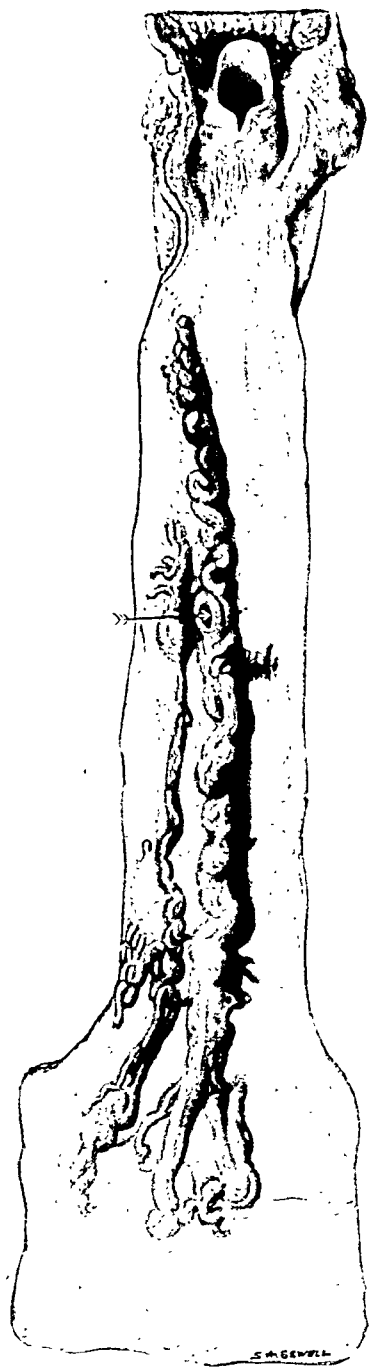
A pharynx and œsophagus divided longitudinally through the posterior wall.

An extensive varix occupies the anterior wall of the œsophagus from the lower end to within $1\frac{1}{2}$ in. of the cricoid. Just above its centre is an ulcerated opening.

Manchester University, 24.144

CLINICAL HISTORY.—The patient was a woman, aged 32, who died from hæmatemesis. She had been treated for Banti's disease for four and a half years, and had vomited blood on several occasions. When admitted to hospital about two months before her death she was pale and thin, with a large spleen, a moderately enlarged liver, and ascites. The blood-count showed: red cells 1,264,000, Hb 10 per cent, white cells 2400—polymorphs 68.6 per cent, lymphocytes 25.4 per cent, large mononuclears 7.5 per cent, eosinophils 1.5 per cent, mast cells 2 per cent.

AUTOPSY.—Spleen greatly enlarged (1008 grm.) and bright red. Liver cirrhotic, with many hyperplastic nodules. Dilatation and thrombosis of portal and splenic veins. Ascites. Ruptured œsophageal varix, with a large mass of recent blood-clot in the stomach.



MANCHESTER UNIVERSITY, 24.144

DUODENAL ULCER.

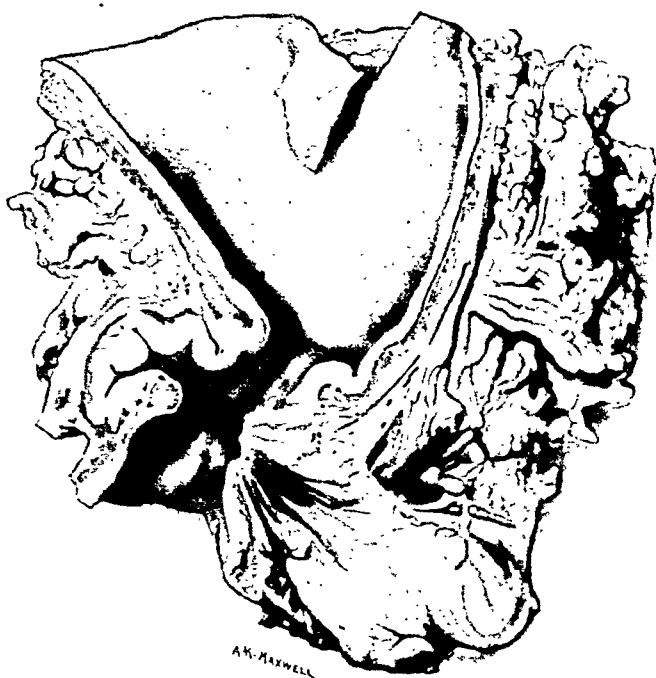
The pyloric portion of a stomach and the first part of the duodenum divided by longitudinal section.

A small chronic ulcer is situated on the lower border of the duodenum immediately beyond the pylorus. It has perforated the whole thickness of the muscular coat of the duodenum, and its floor is formed by great omentum.

Museum of University College Hospital, 3.T.C

CLINICAL HISTORY.—The patient was a thin man, aged 54, who had had attacks of epigastric pain, relieved by food, for twenty years. The attacks came on at intervals of about three months and lasted from three to four weeks. Vomiting had been an occasional symptom for six years. On clinical examination no peristalsis was seen nor was any mass felt.

X-ray examination after an opaque meal showed a considerable residue in the stomach at the end of six hours. The specimen illustrated was removed by operation. Convalescence was uninterrupted.



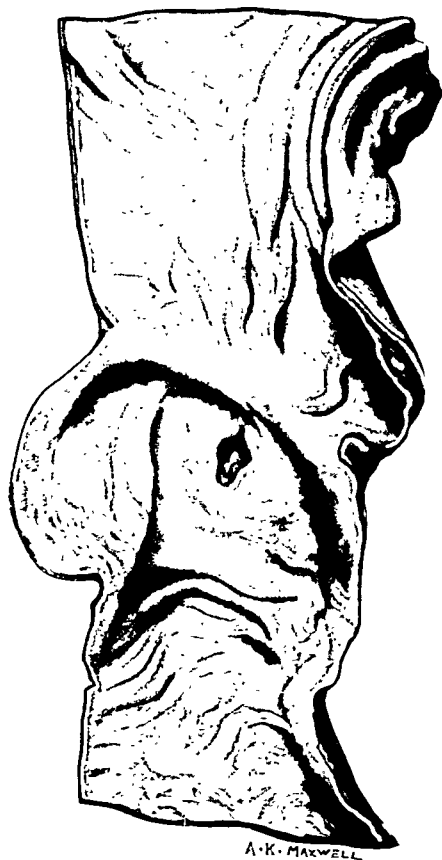
MUSEUM OF UNIVERSITY COLLEGE HOSPITAL, 3.T.C

DUODENAL ULCER.
(ASSOCIATED WITH BURN.)

The pyloric portion of a stomach with part of the duodenum.

In the duodenum there are two deep circular ulcers ; one lies immediately beyond the pylorus, the other about 3·7 cm. from it. The floor of the proximal ulcer is closed only by peritoneum. *Hunterian Museum, R.C.S. 679.1*

CLINICAL HISTORY.—The patient was a boy, aged 7, who was extensively burnt on the front and the back of the body. In front the skin and subcutaneous tissue were destroyed from a little above the clavicles to within three inches of the pubes, so that when the slough separated the muscles were laid bare. The back was affected to a similar extent, though less deeply. He died four weeks after the injury. He had not suffered during his life from any intestinal symptoms.



HUNTERIAN MUSEUM, R.C.S. 679.1

GASTRIC ULCER.

(HEALING.)

Part of a stomach, opened, and drawn from the mucous surface.

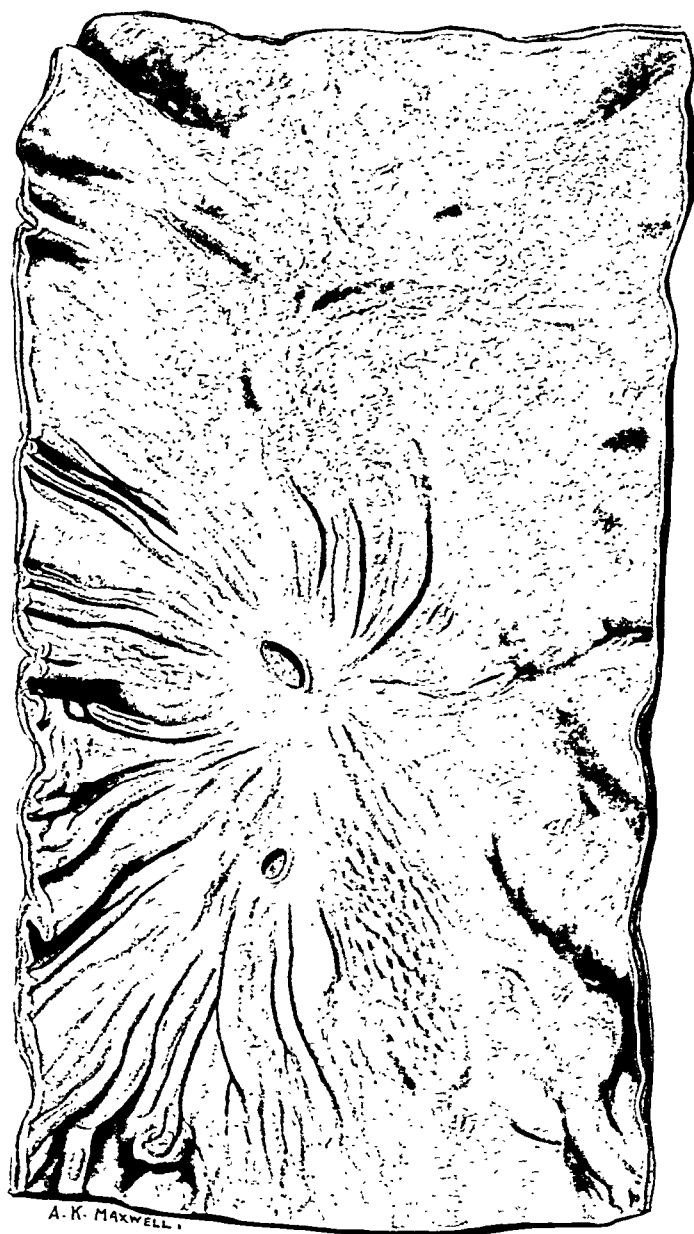
On the lesser curvature are two oval ulcers, 8 mm. and 4 mm. respectively in their longer diameters. The larger ulcer lies 9 cm. from the pylorus; the other is about 2 cm. further from it.

The edges of the ulcers are smoothly rounded, and their bases covered with granulation tissue. The absence of rugæ in the neighbourhood of the larger ulcer indicates that it was once considerably more extensive.

Hunterian Museum, R.C.S. 280.1

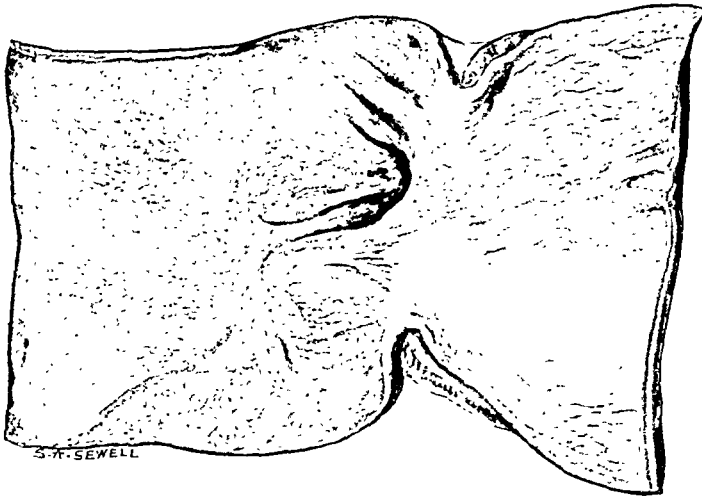
CLINICAL HISTORY.—The patient was a woman, aged 56, who had been ill for two weeks with pain in the right side of the abdomen. An abscess in this position was opened and drained. A right-sided empyema which subsequently developed was also drained.

AUTOPSY.—A recently perforated duodenal ulcer was found close to the pylorus.



HUNTERIAN MUSEUM, R.C.S. 280.1

HEALED DUODENAL ULCER.



The mucous surface of a pylorus with adjacent portions of the stomach and duodenum. The specimen has been opened through the anterior wall.

The scar of a healed ulcer occupies the posterior surface of the duodenum. $\frac{3}{4}$ in. from the pylorus. The latter is distorted by contraction of the cicatrix. Much fibrosis of the peritoneal coats is visible from the outside of the specimen.

Pathological Museum, Leeds School of Medicine, E.251

CLINICAL HISTORY.—The patient was a man, aged 24, who died of tuberculosis of the hip and amyloid disease. The records contain no reference to dyspeptic symptoms.

HEALED GASTRIC ULCERS.

Part of the posterior wall and lesser curvature of a stomach.

Near the lesser curvature are the scars of two healed chronic ulcers. There is extensive fibrosis of the muscular and peritoneal coats, with old peritoneal adhesions. On the mucous surface healing is complete, and the sites of the ulcers are represented by pale, puckered areas.

Pathological Museum, Leeds School of Medicine, E.182

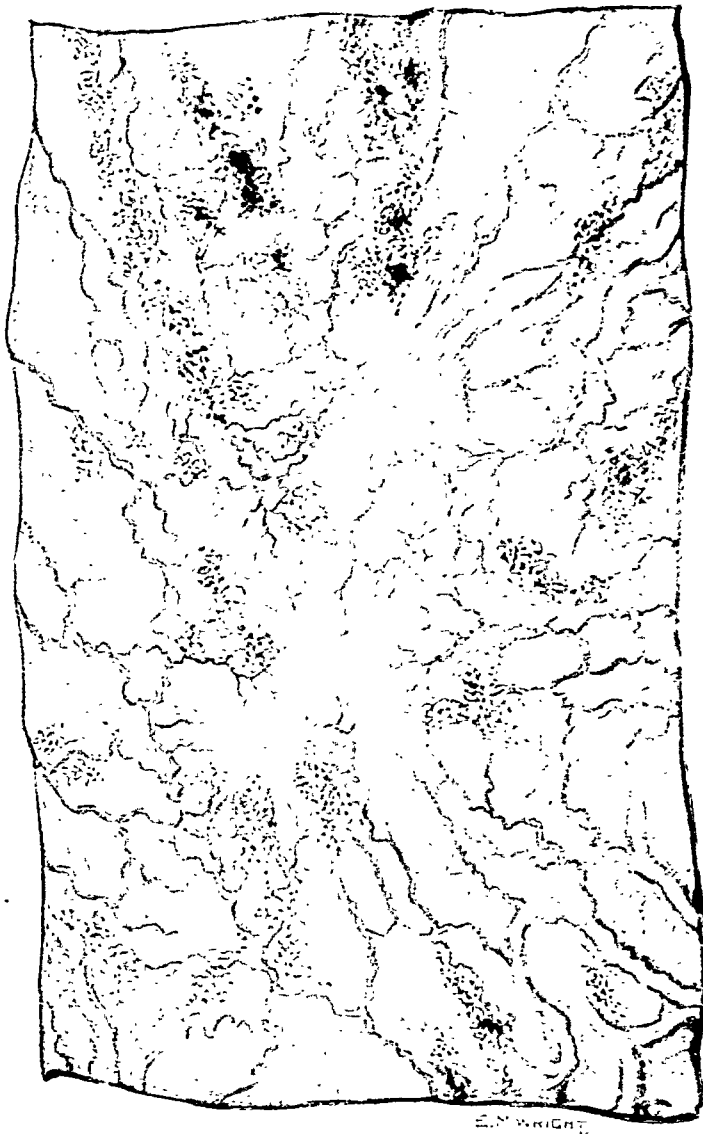
CLINICAL HISTORY.—The patient was a woman, aged 45. There is no history of abdominal symptoms. The notes refer only to the terminal acute illness.

AUTOPSY.—Cause of death: pulmonary thrombosis with abscess of lung; bilateral pyosalpinx with terminal peritonitis.

On the lesser curvature and posterior wall of the stomach, slightly nearer the cardia than the pylorus, are two scars of healed gastric ulcers. Old adhesions pass from the peritoneal surface of these scars across the lesser sac.



PERITONEAL SURFACE.



E. N. WRIGHT

MUCOUS SURFACE.

PATHOLOGICAL MUSEUM, LEEDS SCHOOL OF MEDICINE, E.182

JEJUNAL ULCER.

The first 3 in. of a jejunum with the portion of stomach concerned in a gastrojejunostomy opening, opened, and drawn from the mucous surface.

A chronic jejunal ulcer is situated almost exactly opposite the stoma. It measures $\frac{1}{2}$ in. in diameter and shows a smaller, deeper excavation in its floor towards one margin. Perforation has been prevented by a pad of fibrosed fat in the floor of the ulcer.

Pathological Museum, Leeds School of Medicine, E.261

CLINICAL HISTORY.—The patient was a man, aged 48, who had had a posterior gastrojejunostomy performed four years before admission to hospital. He remained well for three and a half years, at the end of which time he began to feel an aching pain in the umbilical region after food. Five weeks before admission he had a severe attack of hæmatemesis and melæna.

X-ray examination showed that the stomach emptied slowly—mainly through the pylorus. There was no retention of barium in the jejunum.

At operation a jejunal ulcer was found attached to the posterior abdominal wall. The loop containing the ulcer was excised and an end-to-side anastomosis established.



PATHOLOGICAL MUSEUM. LEEDS SCHOOL OF MEDICINE, E.261

JEJUNAL ULCER.

(PERFORATION.)

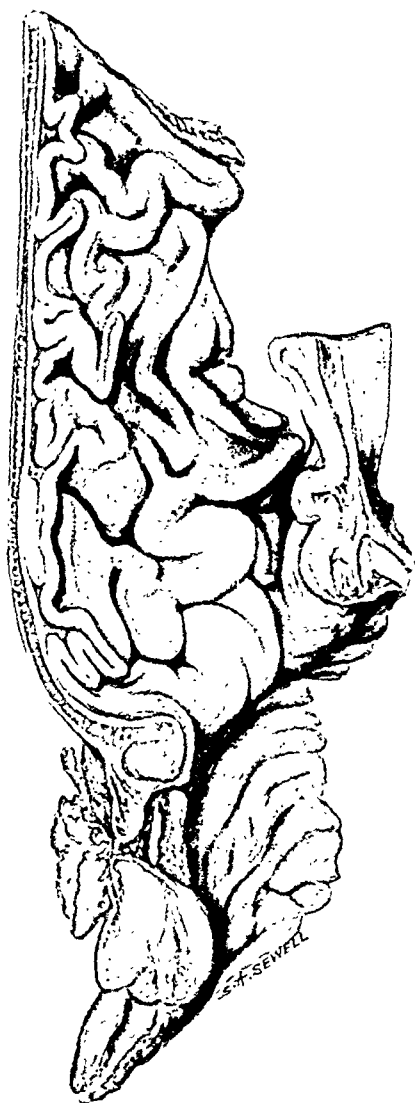
The portions of a stomach and jejunum concerned in a gastrojejunostomy.

The plane of section passes from above down through the stomach, the gastrojejunostomy opening, and the jejunum. A chronic ulcer is situated on the posterior wall of the jejunum, half-an-inch below the stoma. A small perforation passes through its floor into an adherent pad of fat.

Pathological Museum, Leeds School of Medicine, E. 261.A

CLINICAL HISTORY.—The patient was a man, aged 47, upon whom a posterior gastrojejunostomy was performed for a large duodenal ulcer which was adherent to the pancreas and gall-bladder.

His pain at first ceased, but recurred eight weeks after the operation. It was in the same place as before, but was not so severe. It appeared at any time after a meal, and lasted three to four hours. He felt sick after food, but never vomited. X-ray examination showed that the stomach emptied almost entirely through the pylorus. At the second operation, which was performed four months after the first, an ulcer was found in the jejunum, opposite the gastrojejunostomy opening. Partial gastrectomy was performed.



PATHOLOGICAL MUSEUM. LEEDS SCHOOL OF MEDICINE, E.261.A

JEJUNOCOLIC FISTULA FOLLOWING GASTROJEJUNOSTOMY.

Portions of the stomach, duodenum, jejunum, and transverse colon seen from the front. The dilated third part of the duodenum, the duodenojejunal flexure, and the commencement of the jejunum occupy the lower border of the drawing, and the portion of transverse colon is attached in a vertical position to the jejunum.

At the duodenojejunal flexure is a gastrojejunostomy stoma. Close to it is an opening of $\frac{3}{4}$ in. diameter which leads from the efferent loop of the jejunum into the transverse colon. The opening, the jejunocolic fistula, is indicated by an arrow.

Museum of University College Hospital, 15.S.2

CLINICAL HISTORY.—The patient was a woman, aged 35, who had had gastrojejunostomy performed for pyloric stenosis two years before. On admission to hospital there was stercoraceous vomiting without intestinal obstruction. She died two days after an exploratory operation which failed to reveal the cause of vomiting.

AUTOPSY.—The stomach was greatly dilated and its mucous membrane was thickened by inflammation. The puckered scar of a healed ulcer involved two-thirds of the circumference of the duodenum close to the pylorus. The transverse colon was adherent to the front of the gastrojejunostomy, with an opening leading from the jejunum into the colon. There was no evidence of acute or recent ulceration around the margin.

The small intestine and the colon on the proximal side of the fistula were moderately distended. On the distal side the colon was contracted and empty.

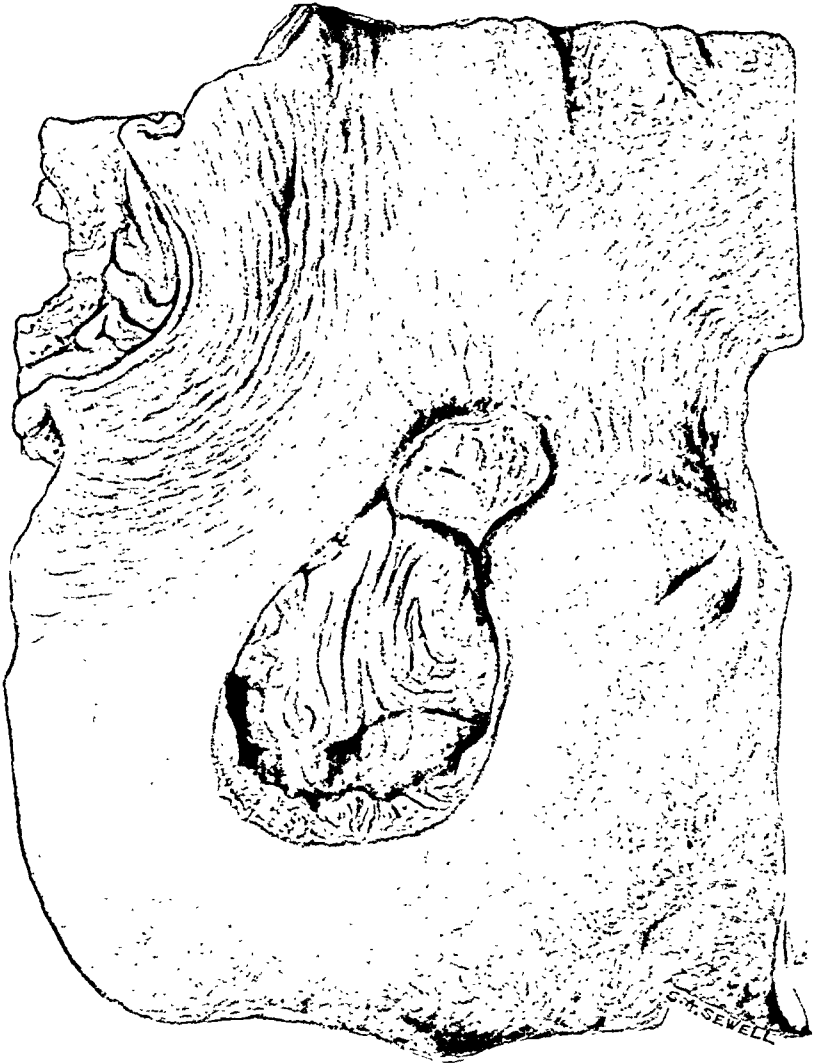


MUSEUM OF UNIVERSITY COLLEGE HOSPITAL, 15.S.2

NO. 8—SUPPLEMENT

H 2

GASTROJEJUNAL ULCER.



Portions of a stomach and jejunum between which an anastomosis has been made. The specimen is drawn from the mucous surface of the stomach, and the jejunum is seen through the anastomotic opening.

At the margin of the stoma is a chronic ulcer.

Pathological Museum, Leeds School of Medicine, E.262

CLINICAL HISTORY.—The patient was a man, aged 39. Six years before, he had had an operation for duodenal ulcer, when the ulcer was infolded. Two years later, owing to continued symptoms of ulcer, posterior gastrojejunostomy was performed. After this operation he remained well for three years, and then began to have attacks of severe epigastric pain after food.

X rays showed an ulcer in the neighbourhood of the anastomosis.

VII. POLYPUS OF THE STOMACH.

POLYPI of the gastric mucous membrane may be single or multiple, sessile or pedunculated. They usually have the structure of an adenoma.

Multiple polypi are small and are commonly associated with chronic gastritis. They may be distributed extensively throughout the small intestine as well as in the stomach. A single, large, pedunculated polypus may be the starting-point of a gastric intussusception, or may obstruct the pylorus. An illustration of malignant disease occurring in association with gastric polypi is given on pages 132, 133 of the Supplement.

POLYPUS OF STOMACH.

(GASTRIC INTUSSUSCEPTION.)

A stomach, duodenum, and pancreas, together with a portion of the œsophagus. The anterior wall of the pyloric canal and first part of the duodenum have been cut away, except for the pyloric ring.

A polypus is attached by a long stalk to the middle of the anterior wall of the stomach. Part of it has been carried through the pylorus and is projecting into the duodenum. Traction on the pedicle has produced an invagination of the anterior wall of the stomach.

Manchester University, 24.148

MICROSCOPIC STRUCTURE.—Adenomatous polyp.

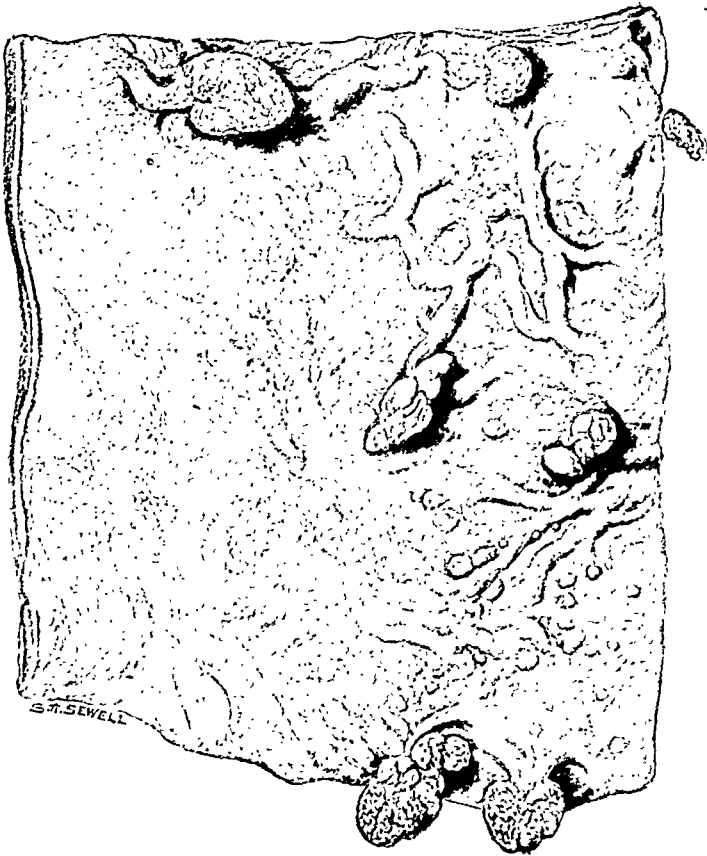
CLINICAL HISTORY.—The patient was a man, aged 58, who was admitted to hospital in a moribund condition. There are no further clinical records.

AUTOPSY.—The peritoneal cavity contained a large quantity of free, clear fluid.



MANCHESTER UNIVERSITY, 24.148

POLYPI OF STOMACH.



A portion of the wall of a stomach.

Several pedunculated polypi spring from the mucous membrane.

Hunterian Museum, R.C.S. 1512.1

MICROSCOPIC STRUCTURE.—The polypi are adenomata.

CLINICAL HISTORY.—The patient was a man, aged 21, who died after an operation for intussusception of the duodenum. During the twelve months which preceded his death he suffered from attacks of severe abdominal pain and vomiting.

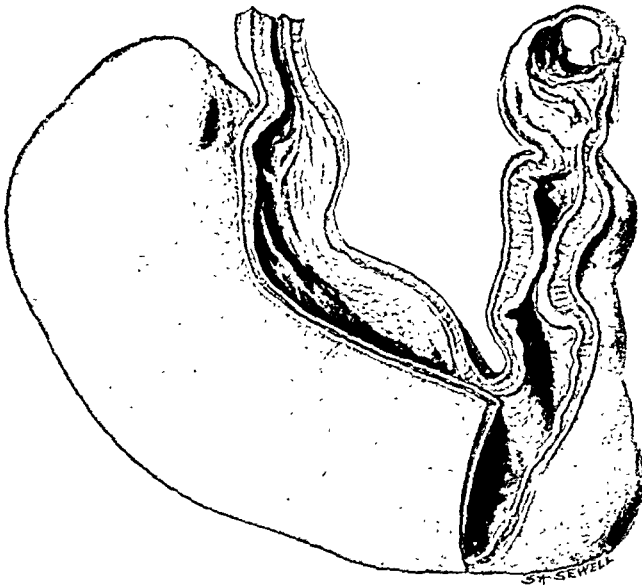
AUTOPSY.—Similar pedunculated growths were scattered throughout the stomach and small intestine. They were most numerous in the duodenum and jejunum.

VIII. INFANTILE HYPERTROPHIC STENOSIS OF THE PYLORUS.

IN this disease there is hyperplasia of the circular muscle of the pylorus, and the contents of the stomach are thereby prevented from passing into the duodenum. The stomach becomes dilated and hypertrophied in consequence of the obstruction to its outlet, and some degree of inflammation of the mucosa may follow the retention of its contents.

Infantile stenosis of the pylorus is four times as common in boys as in girls, and usually causes vomiting, with consequent wasting and constipation, during the first few weeks of life. The tumour produced by hypertrophy of the pyloric muscle is large enough to be felt on clinical examination in a considerable proportion of cases.

HYPERTROPHIC STENOSIS OF PYLORUS.



The stomach of an infant, opened by removal of parts of its posterior wall.

At the pylorus the muscular coat is hypertrophied for a distance of 2 cm., its maximum thickness being 0.5 cm.

Hunterian Museum, R.C.S. 9.1

CLINICAL HISTORY.—The patient was an infant who was well nourished and weighed ten pounds at birth, but who died of vomiting at the age of five weeks.

